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ABSTRACT

This report is based on a survey of 4,678 children aged 6 to 9, examining their exercise habits at school, at home, and in community programs. The survey is the second in a series carried out by the Office of Disease Prevention and Health Promotion. The first report found that fitness has declined for 10- to 17-year-olds. In an effort to better understand why adolescents' fitness levels have declined, this national study was undertaken to learn the fitness status of younger children. The study shows that young children in America are fatter than children 20 years ago, are not getting the right kinds of exercise, and spend more time watching television than in physical activity. The better performers on the fitness tests participate in more vigorous and organized community-based activities, watch less television, and have a higher activity level. The research process and results are described in articles which include: an introduction (J. M. McGinnis); a summary of findings (James G. Ross and Russell R. Pate); "Study Procedures and Quality Control (James G. Ross, et al.); a sample design (Michael T. Errecart et al.); "The Modified Pull-Up Test" (Russell R. Pate et al.); and "Home and Community in Children's Exercise Habits" (James G. Rose et al.). (JD)

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Summary of Findings from

National Children and Youth Fitness Study II

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Public Health Service

Office of Disease Prevention and Health Promotion

U.S. Department of Health and Human Services

Introduction

J. Michael McGinnis

When the findings of the 1985 National Children and Youth Fitness Study (NCYFS) showed that a full third of youth were not physically active enough for aerobic benefit, the nation was surprised and embarrassed. Americans are accustomed to seeing themselves as a country of Olympic champions, Super Bowl heroes, and rodeo stars. The implication was that our children were going soft.

How could this happen? Since physical activity patterns and attitudes are often influenced in important ways by factors presented before age 10, various educators, policy makers, and youth advocates called for a study of younger children to try to get answers. The Second National Children and Youth Fitness Study (NCYFS II) was undertaken by the Public Health Service in 1985 and, with this publication, the first description of health-related fitness for school children, ages 6 to 9, is available on a national probability sample of children.

What we find with the initial analyses of NCYFS II is that the health-related physical fitness of young children is significantly associated with certain physical activity behaviors of the children themselves and their parents. Those children who watch more television, have less active parents, and participate less in community activities tend to score lower on health-related fitness measures. Overall, younger children weigh more and have more body fat than they did 20 years ago. While virtually all early elementary school children take physical education (97 percent), only about a third do so daily. This is consistent with what we learned about the older children.

The articles which follow describe the research process and discuss the results of NCYFS II in greater detail. The data offer a significant contribution to the body of knowledge about physical activity and children, making a good first strike into the murky area of patterns and determinants of childhood physical activity and the behavioral patterns that are more likely to carry over into adulthood.

We encourage secondary analyses by the research community in order that we can get further insights into how to improve the health and fitness of our young people. The data tapes of both NCYFS I and NCYFS II will be available through the National Technical Information Services (NTIS).*

Many organizations and individuals deserve recognition for their collaboration in the design of the study: the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD); the National Recreation and Parks Association; the Committee on Evaluation Information Systems (CEIS) of the Council of Chief State School Officers; the Society of State Directors of Health, Physical Education and Recreation; the President's Council on Physical Fitness and Sports; the National Center for Health Statistics; the Centers for Disease Control; many in the physical education research community; individuals and other organizations involved in school curriculum development, physical education programs, and community recreation; and, of course, the thousands of school principals, teachers, parents, and children who cooperated in the study.

AAHPERD is to be commended for helping to get the survey results out in a timely manner to those who can best use the information—practicing physical educators. I would also like to commend the work of people who played key roles in the success of the study: Dr. Robert Gold and Cheryl Damberg, the initial project officers with the Office of Disease Prevention and Health Promotion who supervised and directed the study; Dr. Gregory M. Christenson who helped complete the project at ODPHP and helped prepare this insert. Jim Ross, the project director, and the capable staff at Macro Systems, Inc. executed the study.

Through the combined efforts of this team of individuals and organizations, we have been able to maintain the quality and integrity established in the initial NCYFS study.

Ultimately, the success of the survey will be measured by the degree to which it can stimulate change and encourage progress. The data from NCYFS I and II will contribute greatly in providing needed baseline information as we approach the time to set new exercise health objectives for the year 2000. Success in meeting those objectives, however, will depend on the continuing support and contribution of all those who have participated in this initiative, the schools and education community at-large, and the families of this nation's children.

*For information about the NCYFS I and II data tapes, contact Jim Ross, project director, Macro Systems, Inc., (301) 588-5484.

—J. Michael McGinnis, M.D., Deputy Assistant Secretary for Health and Director, Office of Disease Prevention and Health Promotion, U.S. Department of Health and Human Services, Washington, DC 20201.

A Summary of Findings

James G. Ross □ Russell R. Pate

The information from NCYFS II suggests that current programs may be inadequate to promote lifetime fitness. Study findings challenge policy makers, researchers, teachers, and community members to make informed decisions about actions needed to enhance the future fitness and physical activity habits of our children.

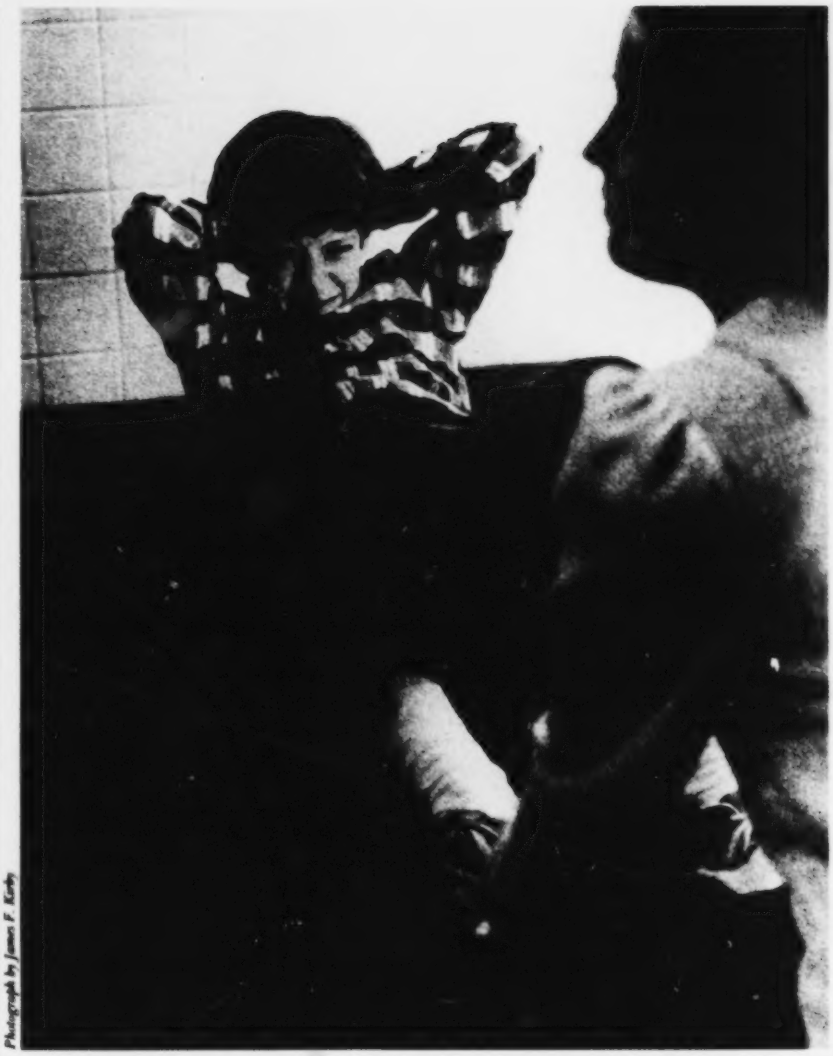
Many people believe that children are naturally active and fit. Yet, incongruously, media pundits warn that the adult fitness boom has failed to trickle down to our children, as if children needed motivation to be physically active. Although younger school children rank physical education as their favorite subject (Gallup, 1985), high school juniors and seniors generally choose not to take physical education as one of their electives (Ross & Gilbert, 1985).

Not long ago, it was widely believed that degenerative diseases, such as atherosclerosis, begin in middle age. Now we know that such afflictions have their roots in childhood and that, by intelligent behavioral choices, we can sharply reduce our risks of degenerative disease. Within the range of choices, participation in a regular exercise regimen is one of the best ways of lowering risk and reducing the occurrence of degenerative diseases (Powell, Thompson, Caspersen, & Kendrick, 1987).

While advertisers publicize the association between their products and an active lifestyle, statistics show that no more than 10 percent (Caspersen, Christenson, & Pollard, 1986) to 30 percent (Schoenborn, 1986) of adults participate in regular, vigorous exercise.

Are children naturally active and fit? For the sake of argument, let us assume that, until the age of 10 or so, they are. What changes as children grow older? As parents, teachers, and members of society at large, are we failing to nurture this healthy inclination? Do schools punish children for being active, much akin to the process of breaking a wild horse? As parents, do we use the television too often to control behavior? Are we intolerant of a child's need for physical activity? Are we perhaps not pushing our children hard enough to remain active? Are we perhaps not pushing our children hard enough? Or are we pushing the few too quickly into competitive sports to the near exclusion of the many? Do we offer children the right options? Are adequate resources for exercise made available at home, at school, and in the community? Do we set the right example by our own lifestyles? Have we made it too easy for children to adopt a sedentary lifestyle? As children mature and become more self-conscious, is it natural that physical activity take a lower position on their list of priorities? In the final analysis, this question must be addressed: What needs to happen to foster a national commitment to lifetime fitness?

Against this background, the second National Children and Youth Fitness Study (NCYFS II) was launched to study the physical fitness and physical activity habits of children ages six to nine. Specifically, the study is the first to assess the fitness of six- to nine-year-olds, to describe their patterns of participation in physical activity, and to determine the factors affecting their fitness. This article describes the impetus behind the study,



Photograph by James F. Kirby

methods of collecting data, and major study findings.

Impetus behind NCYFS II

The original National Children and Youth Fitness Study (NCYFS I), limited to 10-to 18-year-olds, was designed to gather baseline data related to national objectives in physical fitness and exercise (Ross & Gilbert, 1985). The landmark document, *Promoting Health/Preventing Disease: Objectives for the Nation* (1980), set as objectives that 90 percent of 10- to 17-year-olds will participate in vigorous exercise, 60 percent will be enrolled in daily physical education, and 70 percent will participate in periodic fitness testing by 1990. Two other objectives call for data for monitoring patterns of participation in physical activity and for evaluating the short- and long-term health benefits of exercise.

There were three reasons for extending the NCYFS I to younger children. First, in the official midcourse review of the 1990 objectives for the nation, professionals in the field argued that greater attention to early elementary school children would improve prospects of reaching older children and adolescents (Powell, Spain, Christenson & Mollenkamp, 1986). Second, when findings of NCYFS I were released in 1984, the general public and the media repeatedly asked why younger children were excluded. In essence, they argued for lifetime fitness. Third, the U.S. Department of Education's 1986 report, *First Lessons: A Report on Elementary Education in America*, acknowledged the importance of physical education programs in schools, "not only because they promote health and well-being, but because they contribute to academic achievement" (Bennett, 1986).

Project history

NCYFS II began in October 1985 with the convening of two panels to help design a battery of fitness tests and a survey of physical activities. Fitness test and survey protocols were developed, extensively pilot-tested, and refined. Data were collected between September and November 1986 from a nationally representative sample of 4,853 students in 19 states, of whom 4,678 participated. In addition, 4,435 of the parents of participating students completed a parent survey. The participation rates of over 96 percent for children and 94 percent for parents are extremely high for a survey of this type.

Study questions

NCYFS II posed three general questions about the fitness and physical activity habits of American six- to nine-year-olds:

(1) How do children in grades 1 to 4 perform on health-related tests of physical fitness?
(2) What are the physical activity habits of children at home, at school, and in the community?
(3) What factors, including exercise habits, affect measured fitness?

The question about performance on fitness tests was primarily intended to produce descriptive statistics; i.e., fitness norms that describe the population, provide a baseline for tracking changes over time, and allow comparison of in-

dividual students against the population. Compared to national data obtained in the 1960s, NCYFS I detected an increase in the body fatness of 10- to 18-year-olds (Ross & Gilbert, 1985). It was also intended for NCYFS II to examine whether such changes occurred in six- to nine-year-olds.

Several questions were posed regarding physical education programs: What percentage of younger children are enrolled? Do they take physical education classes with sufficient frequency? What percentage take it daily? Do most take it from a certified physical education specialist rather than a classroom teacher? Are classes held in a suitable physical environment? What types of activities are most frequently offered? Are the children periodically tested for physical fitness? In testing, is the focus on health-related fitness or motor performance? How do extracurricular physical activity programs fit into the picture? Are recess periods used to supplement or to substitute for physical education? Most important, do physical education programs provide support for lifetime fitness?

Regarding home and community, such questions were posed as: What percentage of children make use of community organizations—such as sports teams, YMCA's, parks and recreation department programs, and scouting—as sources of exercise? In what physical activities do children engage through such organizations? Do parents and teachers perceive children as being rather sedentary? Are children who watch greater amounts of television actually less active and less likely to participate in community organizations? What models do parents set by their own exercise patterns? How often do parents exercise with their children?

Finally, it was asked: What are the relationships of the child's own activity levels, the child's participation in community organizations, parental exercise behavior, and the school physical education program to the measured fitness of the children?

Data collection procedures

The parents of the participating children first filled out a survey describing their own and the child's physical activity patterns. The survey was administered in conjunction with a parental consent form. Information about the school physical education program was collected directly from teachers. Next, each of the 4,678 participating children completed a set of fitness tests. Cardiorespiratory endurance was measured through a one-mile walk/run (age 8 and over) or a half-mile walk/run (under age 8). A sit-and-reach test using a special apparatus measured lower back/hamstring flexibility. Upper body muscular strength endurance was tested by a modified pull-up in which the student's heels remain on the floor. Timed, bent-knee sit-ups, with the student's arms folded across the chest, measured abdominal strength/endurance. Finally body composition (degree of fatness) was measured by triceps, subscapular, and medial calf skinfolds.

Testing procedures were designed to maintain control over the quality of collected data. Well in advance of the scheduled testing date, teachers demonstrated all of the tests and provided students with an experience in paced running. A roving cadre of trained specialists actually administered the tests to students one-on-one except for the distance run, which was administered in small groups. The role of the teacher in data collection was primarily limited to assistance in administration of the distance run.

The new norms

NCYFS II developed new health-related fitness norms by age/sex and grade/sex for each of the fitness tests listed above.

The study marked the first occasion on which most of these tests were administered to a nationally representative sample of six- to nine-year-olds. The norms are considered highly accurate at every fifth percentile. Average scores can be seen in Exhibit 1.

Each of the five tests is intended to measure one or more aspects of

Exhibit 1. Average Score for Boys and Girls on the NCYFS II Fitness Tests by Age

Test Item	Fitness Dimension Measures	Boys				Girls			
		6	7	8	9	6	7	8	9
Sum of Triceps, Subscapular and Medial Calf Skinfolds (mm)	Body Composition	24.56	26.36	28.91	32.07	30.55	32.25	36.11	39.16
Sit-and-Reach (Inches)	Flexibility	13.23	13.19	13.03	12.61	14.10	14.37	14.09	14.05
Bent-Knee Sit-Ups (Number in 60 Seconds)	Abdominal Strength/ Endurance	18.41	22.38	25.20	27.89	17.79	21.42	23.89	25.49
Modified Pull-Ups (Number Completed)	Upper Body Strength/ Endurance	7.28	9.16	10.58	11.51	6.64	8.08	8.58	8.92
Mile Walk/Run (Minutes and Seconds)	Cardiorespiratory Endurance			11:04	10:37			11:58	11:35
Half-Mile Walk/Run (Minutes and Seconds)	Cardiorespiratory Endurance	5:31	5:10			5:48	5:33		

an individual's current health and potential resistance to disease. Poor performance on the sit-and-reach and sit-up tests indicates the possibility that an individual might develop lower back or other musculoskeletal problems due to inadequate flexibility and/or poor abdominal strength. Distance runs measure the generalized capacity of the cardiovascular system; maintaining a high capacity may reduce an individual's risk of heart disease. A high degree of body fatness, as shown by skinfold thickness, helps to predict vulnerability to a wide range of degenerative diseases, including hypertension, heart disease, diabetes, psychological disorders, and impaired tolerance for heat. Upper body strength as measured by modified pull-ups indicates an individual's ability to perform certain functional tasks required in day-to-day living without undue exertion or risk of injury.

Changes in body fatness

Population-wide changes in physical fitness are matters of scientific and practical concern because they imply alterations in the capacity to work and play, adjustments to the quality of life, and shifts in vulnerability to various health problems. Efforts to assess changes in health-related fitness are largely limited to tracking changes in skinfold measurements. Valid national data for most tests of health-related physical fitness were not collected prior to the mid-1980s.

Comparison of NCYFS II scores for triceps and subscapular skinfolds to data previously collected by the National Center for Health Statistics in 1963-1965 provides evidence that six- to nine-year-old children carry more body fat than did their counterparts of 20 or more years ago. The median sum of the two skinfolds was two to four mm thicker than in the earlier sample. Further research is needed to verify and further define such apparent changes and to interpret their implications for the health of today's children.

Physical education programs

Nearly all children attend school; therefore, the school plays a pivotal role in influencing their physical fitness and exercise habits. As expected, virtually all first through fourth graders (97.0%) are enrolled in physical education programs of one sort or another. It comes as a pleasant surprise that they take physical education an average of 3.1 times weekly, with 36.4 percent taking classes daily. However, it appears that a two-class system has evolved at an early elementary school level. The "haves" take physical education daily while the "have nots" (37.2%) take physical education only one or two days a week.

It is interesting that the frequency with which schools conduct physical education classes is inversely related to the amount of time the children are given for recess. This suggests that schools are inappropriately using recess to substitute for, rather than to supplement, physical education. Children need discretionary time just as they have a need for physical education instructional time. This also suggests that schools are willing to allocate just so much time to physical activity.

It came as a surprise that over three quarters (76.0%) of children never see a classroom teacher for physical education and that 83.1 percent take class at least once a week with a physical education specialist. However, this finding alone masks the fact that many specialists, perhaps as many as one third, do not hold a valid certification in physical education. There is cause for concern that many schools do not make the investment needed to hire a certified physical education specialist.

In this age group, only 39.3 percent of students typically take physical education in a gymnasium. This is not in itself cause for alarm because schools in temperate climates usually hold physical education on the school grounds. As a result, children who take physical education on school grounds have the benefit of 50 percent more class meetings per week than children who take physical education indoors. However, there is concern that more than a few schools not providing physical education specialists appear to be unwilling or unable to support adequate teaching facilities.

Although 49.5 percent of students have the opportunity to participate in periodic fitness testing, schools generally test for motor performance rather than health-related fitness. A major obstacle is that, by their own admission,

Exhibit 2. Rank and Percent Reporting Physical Activities Most Frequently Performed by Boys and Girls in Community Settings, Grades 1-4

Boys	%	Rank	%	Girls
Swimming	.36	1	.39	Swimming
Racing/Sprinting	.33	2	.32	Racing/Sprinting
Baseball	.23	3	.15	Bicycling
Soccer	.21	4	.14	Playing on a Playground
Bicycling	.15	5	.10	Gymnastics
Playing on a Playground	.11	6	.10	Walking
Football	.10	7	.08	Basketball
Basketball	.09	8	.08	Climbing
Climbing	.08	9	.08	Hiking/Backpacking
Hiking/Backpacking	.07	10	.08	Locomotor Skills
Locomotor Skills	.07	11	.08	Playing (unspecified)
Walking	.07	12	.07	Jumping or Skipping Rope
Calisthenics/Exercises	.06	13	.07	Roller Skating
Playing (unspecified)	.06	14	.06	Soccer
T-ball	.05	15	.05	Games (unspecified)
			.05	Ballet/Square/Folk Dance

teachers are not aware of or do not know how to administer the newer fitness tests.

Only 18.9 percent of students have the opportunity to participate in extracurricular sports and physical activity programs at school; the percentage who actually do is even lower. The most frequently offered activities, in declining rank order, are basketball, jumping or skipping rope, soccer, games (unspecified), baseball/softball, folk/square/ballroom dance, gymnastics, and track and field (not running). Over the four grades, priorities begin to shift in grade 3, as competitive team sports, such as basketball and soccer, replace jumping or skipping rope and rollerskating as top activities.

The most common physical education class offerings in grades 1-4 are, in declining rank order: movement experiences and body mechanics, soccer, jumping or skipping rope, gymnastics, basketball, throwing and catching activities, calisthenics/exercises, rhythmic activities, kickball, relays, running, and baseball/softball. However, grades 1-4 define a period of marked transition, as physical education programs shift from an emphasis on movement education toward greater interest in physical fitness and sports skills. By grade 3 or 4, movement experiences, locomotor activities, and throwing and catching activities give way to competitive team sports, such as baseball/softball, basketball, soccer, and volleyball, which will remain the core of the physical education program throughout high school.

The dramatic shift toward team sports in physical education and extracurricular offerings as early as grades 3 and 4 causes alarm. One of the key assumptions in the *Objectives for the Nation* related to school physical education is that, "school based programs will embrace activities which expand beyond competitive sports." NCYFS I found that present programs for grades 5-12 are not geared to this goal. NCYFS II provides evidence that

Photograph by Greg Merbar

physical education offerings, testing programs, and extracurriculars in grades 1-4 do not support a goal of lifetime fitness either.

Home and community

Although schools are important to the child's exercise habits, one cannot overlook the roles of home and community, which exert powerful influences in all phases of life among children under age 10. Home and community contribute in significant ways to the physical activity of six- to nine-year-olds. Nearly all children (84.3%) participate in physical activity through at least one community organization. These organizations include public parks and recreation department programs (65.3%), community-based sports teams or leagues (31.9%), churches and other places of worship (24.2%), YMCA's and YWCA's (13.9%), various health clubs and private spas (18.9%), scouting groups (14.6%), and farm clubs (2.1%). Most community organizations are equally available to boys and girls, at least by grade 4. The exception is sports teams and leagues, which attract twice as many boys as girls.

The activities most frequently performed under the auspices of a community organization, in declining rank order, are: swimming, racing/sprinting, baseball/softball, bicycling, and soccer. The next 11 most popular activities, again in descending order are: playing on a playground, climbing, locomotor activities and skills, walking, hiking/backpacking, gymnastics, playing (unspecified), basketball, calisthenics/exercises, football, and rollerskating. However, there are differences between boys and girls in most frequently performed activities and in the relative importance of the different activities (Exhibit 2). As in school programs, priorities change. Baseball/softball, basketball, football, and hiking/backpacking all move up in importance. Climbing, locomotor activities, and playground play decline.

It is significant that fewer than 30 percent of mothers and fathers of first through fourth graders partic-

ipate in moderate to vigorous exercise three days a week, which is the amount generally thought to be required for maximum health benefits. Even more alarming is that approximately 50 percent say that they never engage in vigorous exercise.

The frequency with which mothers and fathers exercise with their children can be presumed to communicate to the child something about the parental value associated with exercise. Both mothers and fathers exercise with their children less than one day per week, on the average. The ones who do are, in large part, the ones who are already setting positive role models by their own exercise behavior. Mothers exercise with sons and daughters with equal frequency. Fathers, however, spend an average of 50 days per year exercising with sons versus only 35 days per year with daughters. This imbalance is most pronounced in grade 4, suggesting the start of a pattern that may last throughout the school years.

NCYFS II indicates that the average child in grades 1-4 spends an average of two hours and two minutes watching television on school days versus three hours and 26 minutes on weekend days. These results are markedly different from some national studies, but are consistent with others. Regardless, television watching does directly take away from time that could be spent in other more constructive activities, including exercise. Children who watch greater amounts of television tend to have lower activity levels and are less likely to participate in organized sports or to engage in physical activity through community organizations.

Parents were asked to rate their own physical activity levels and those of their children against same-sex peers. Among both children and adults, the average male was rated as somewhat above average in physical activity level, while the average female was rated as average for persons of the same age and sex. This mathematical incongruity suggests that there is a very strong bias in how parents and teachers rate children and in how adults rate themselves. Parents tend to view their male children as being only slightly more active compared to same-sex peers than their girl children. However, teachers rate boys as much more active than girls.

Factors associated with fitness

The relationship between physical activity patterns and health-related physical fitness was studied by examining the associations between selected school, community and home physical activity factors and two fitness variables, mile walk/run performance and sum of three skinfold thicknesses. Analyses were conducted with third and fourth graders and were controlled for the effects of age and sex.

The results indicate that the physical activity patterns of children, as reported by their parents and teachers, are significantly related to their physical fitness. Children who perform well on the mile walk/run test tend to participate in more community-based physical activity, to watch less television, and to be rated by their parents and teachers as more physically active. In school, these better performers on the distance run tend to receive more of their physical education instruction from a specialist and have the opportunity to participate in periodic physical fitness testing.

School factors tended *not* to be significantly related to the body composition of children. However, leaner youngsters tended to participate in more community-based physical activities and watched less television. These leaner children were rated as more physically active by both their parents and teachers. It may be particularly important that parental physical activity was associated with body composition of the children. The parents of leaner youngsters were more active and exercised more frequently with their children.

Summary and conclusions

NCYFS II has provided information never before available about physical fitness, physical activity patterns, and factors related to the physical fitness of children in grades 1-4. This information suggests that current programs may be inadequate to promote lifetime physical fitness. Study findings challenge policy makers, researchers, teachers and members of the general community to make informed decisions about actions needed to enhance the future fitness and physical activity habits of our children. Attention needs to be directed to interpreting the results of NCYFS II.

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Study Procedures and Quality Control

James G. Ross □ Lisa A. Delpy □ Gregory M. Christenson
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Documentation of these quality control methods should allow users of the data to focus on the meaning and implications of the results rather than on questions of how the data were collected.

In assessing the fitness and exercise habits of children, quality control techniques give the tester confidence and, ultimately, those using the data, the confidence that each child is measured consistently and accurately, according to a common protocol. Quality control is especially important when test results will be used diagnostically or to detect changes in either fitness or exercise habits.

Typical quality control techniques include pilot testing instructions to ensure consistent interpretation, spot checking administration of a testing protocol, monitoring the calibration of test equipment, and retesting a sample of participants on key measures to establish reliability.

This article explains how quality control was maintained in the National Children and Youth Fitness Study II (NCYFS II). Every effort was made to uphold the standards of rigor set in NCYFS I (Ross & Gilbert, 1985). The discussion is meant to be helpful to researchers as well as to others interested in protecting the integrity of data.

Develop scientifically acceptable protocols

The study protocol had to capture the most current thought on measurement of fitness and physical activity patterns among children. Two panels of experts (Exhibit 1) in physical education and other fields were convened to provide guidance in the development of scientifically acceptable protocols.

The fitness test panel was to update the fitness testing protocol from NCYFS I and adjust it to the special requirements of younger children. The panelists faced three major issues: (1) attempting to find a gender-free test of upper body strength; (2) assessing the need for substitute or supplemental skinfold sites; and (3) determining the appropriateness of a mile walk/run for younger children.

The recommended physical fitness test battery consisted of the following test items for both boys and girls: (1) triceps, subscapular, and medial calf skinfolds; (2) sit-and-reach test (with apparatus); (3) bent-knee sit-ups; (4) modified (Vermont) pull-up; (5) mile walk/run for children aged eight or older; and (6) half-mile walk/run for children under age eight. The panel recommended adding the medial calf skinfold to provide an alternative for the subscapular. The modified pull-up was included as a test of upper body strength because it is gender-free and nearly all youngsters earn a score of at least "1."

The panel recommended that children under age eight only run a half-mile. Although there is no physiological reason why a six- or seven-year-old child cannot run a mile, the panel stressed that most children in the general population have not been trained to do so. The young child's inexperience with endurance activity is compounded by a relatively short attention span. Therefore, a mile walk/run would produce data of questionable validity. Moreover, if participation in fitness tests is intended to serve an educational purpose, a half-mile distance on a walk/run would be sufficient to introduce children to the experience of paced, long-dis-

tance running.

The physical activity survey panelists were to (1) identify the persons from whom accurate reports of a child's physical activity habits and determinants might be collected; (2) select survey variables; and (3) identify specific questions from existing protocols. The panelists recommended that separate surveys be designed for students, parents, and teachers. Furthermore, they recommended that these surveys be designed in such a way to categorize physical activity by level of energy expenditure (e.g., time spent in vigorous exercise, exercise of lower intensity, standing and sitting). The recommendations from both expert panels formed the basis for NCYFS II.

Pilot test protocol to ensure clarity and ease of use

The pilot test offered the chance to identify and revise ambiguous instructions and inadequate directions. The survey and fitness battery had to be clear and easy to use. Instructions and directions that would be interpreted the same way by virtually all administrators, teachers, parents, and students were required. A protocol that was unclear (i.e., that would allow sit-ups to be performed in several different ways) could severely limit the usefulness of the resultant norms.

Refinement of the data collection protocols was an important aspect of NCYFS I and II. The instructions for administration of both the fitness battery and the surveys were continuously scrutinized to ensure specificity in directions and consistency in interpretation. Every problem that arose was carefully weighed and analyzed. Were the instructions unclear? Did the administrator grasp the instruction? How likely was the problem to recur? How significantly does distortion of the directions affect the measurement? Can instructions be written with more precision? Will field staff and assisting teachers need extra training to head off a problem? Should the possibility that a problem might recur be incorporated into monitoring procedures? Can a problem be controlled if the children are better prepared for the tests? Examples of how instructions were revised are presented for the sit-up test, the

Photograph by Greg Merkar

The panel recommended that children under age eight only run a half-mile.

modified pull-ups, the mile walk/run, and the physical activities survey to illustrate the revision process.

The standard protocol for the bent-knee sit-up requires that the student's arms remain folded across and flat against the chest. In the up position, the student must touch the forearms to the thighs without pulling the arms away from the chest. In the down position, the student's mid-back must touch the mat. The buttocks must remain on the mat, no more than 12 to 18 inches from the heels. In the NCYFS I pilot test, several variations in the performance of sit-ups were discovered. The most frequent variation was the tendency for students to push their folded arms away from their chests, sometimes in a vigorous, thrusting motion. A second variation was a tendency for students to lift their buttocks off the mat between sit-ups, producing a rocking effect. To control these and other problems, students were given advance warnings about what constituted acceptable performance. The testing protocol required that instructions to the student be read out loud or stated from memory by the tester.

The modified pull-up test is a relatively new, gender-free test in which a student begins in a supine position and then lifts himself or herself as many times as possible to a level seven to eight inches *below* an adjustable bar set just beyond the finger tips. The back of the student's heels are to remain in contact with the floor; however, no other part of the body may touch down once the test has begun. The lower back should stay straight throughout the test. In the pilot test, it was quickly learned that some students did understand what keeping a "stiff body" meant. Children allowed their buttocks to rest on the floor, which resulted in a premature termination of the test. To correct this problem, two steps were taken. The first was to change the instructions so that students were told to "keep as straight as an arrow" and "be like a torpedo." Additionally, just prior to starting the test, each student was asked to get into a reverse push-up position, which provided them with the feel-

Exhibit 1. National Children And Youth Fitness Study Instrumentation Panels

Panel #1: The Physical Fitness Test Battery

Dr. Oded Bar-Or
Chedoke Hospital, McMaster University

Dr. Carl J. Casperson
Centers for Disease Control, DHHS

Dr. Raymond A. Ciszek
American Alliance for Health, Physical Education, Recreation & Dance

Dr. Robert S. Gold
University of Maryland

Dr. Margie Hanson
American Alliance for Health, Physical Education, Recreation & Dance

Dr. Russell R. Pate
University of South Carolina

Dr. Sharon Plowman, Ph.D.
Northwestern University

Mr. James G. Ross
Macro Systems, Inc.

Panel #1: Contributors And Reviewers

Dr. Ted A. Baumgartner
University of Georgia at Athens

Dr. Charles B. Corbin
Arizona State University

Dr. Lorna Francis, Ph.D.
National Injury Prevention Foundation

Mr. James Liston
National Association of Governor's Councils on Physical Fitness and Sports

Dr. Timothy Lohman
University of Arizona

Dr. Raymond E. Sparks
Vermont Governor's Commission on Physical Fitness

Ms. Helen Stemler
Howard County (Maryland) Schools

Ms. Linda Vanderhoff
Maryland Commission on Physical Fitness

Panel #2: Physical Activities Survey

Dr. Tom Baranowski
University of Texas at Galveston

Dr. Jerome Calderone
National Center for Health Services Research, DHHS

Dr. Robert S. Gold
University of Maryland

Dr. Russell R. Pate
University of South Carolina

Dr. Kenneth E. Powell
Centers for Disease Control, DHHS

Mr. James G. Ross
Macro Systems, Inc.

Dr. James F. Sallis
University of California at San Diego

Mr. Len Tritsch
Oregon Department of Education

Panel #2: Contributors And Reviewers

Dr. Don Bailey
Saskatchewan University

Dr. Raymond A. Ciszek
American Alliance for Health, Physical Education, Recreation & Dance

Ms. Cora L. Craig
Canada Fitness and Lifestyle Research Institute

Dr. Margie Hanson
American Alliance for Health, Physical Education, Recreation & Dance

Dr. Robert Pangrazi
Arizona State University

Ms. Helen Stemler
Howard County (Maryland) Schools

Dr. Thomas Stevens
National Center for Health Statistics, DHHS

ing of a straight back. The use of these procedures virtually eliminated misunderstanding of the instructions for this test.

The most significant difficulty in administration of the distance walk/run was keeping count of the number of laps each child completed. In NCYFS I, the procedure was to pair students and assign responsibility for counting laps and recording times to the runner's resting partner. Eight laps to the mile and 12 children running at a time were set as upper limits. To help the students count laps, a pencil and slip of paper precoded with the required number of laps were provided to the student. Students simply had to cross out a number each time their partner finished a lap. As a runner came across the finish line, the test administrator called out the time and the runner's partner jotted it down on the slip of paper.

Though this procedure worked well for older children, there was concern that younger children might have problems with it. Following a pilot test, it was decided that a precoded teacher checklist could be used. This procedure required students to wear race numbers to simplify keeping track of who was who. Students ran a maximum of eight laps to a mile in groups that generally consisted of no more than six students. One test administrator kept time while a second administrator checked off laps completed. Other procedures kept the children on task and running continuously; e.g., testers checked, if necessary, and helped students to tie their shoe laces before the run and also issued a final warning to, "keep on going, even if your number falls off."

The pilot test demonstrated that neither parents nor students could recall the child's physical activity habits with sufficient reliability to categorize children by level of energy expenditure. As a result, the parent and student surveys were streamlined to collect less detailed information which could be provided more reliably on physical activity habits. The student survey was later dropped altogether.

Use quality equipment and keep it calibrated

Accuracy in fitness testing requires use of quality equipment which is kept in calibration. Each fitness test item involved one or more pieces of equipment. Identical equipment was used at all locations.

To take skinfold measurements, a caliper, a measuring tape (to measure the midpoint between the elbow and shoulder), and a marker (to mark the sites) were required. In NCYFS I, Lange Calipers were used because they have been widely used in national research studies. The same calipers were chosen for NCYFS II. Field staff used a toothed block to check calibration of the calipers before each testing session and recorded the results of the calibration test in a log book. Field staff were instructed to stop using and replace calipers which exceeded calibration tolerances by more than ±1mm. The calibration logs indicated that there were no cases where calibration exceeded acceptable tolerances.

The sit-and-reach test required a special apparatus not available at most schools. Therefore, in order to ensure consistency in the sit-and-reach test, an apparatus that complied with specifications in the AAHPERD Health Related Physical Fitness Test Manual was carried by field staff.

The sit-ups test required an exercise mat (or other cushioned surface) and either a stopwatch or watch with a second hand. Members of the field staff also carried digital stopwatches and most schools had exercise mats. When mats were unavailable, another cushioned surface (e.g., a flat, grassy area) was used.

The modified pull-ups test required a specialized device which no schools in the sample had available. Therefore, NCYFS II provided one for each school and, when testing was completed, the device became the school's property.

To assess performance in the mile walk/run, a measured flat running course and a stopwatch were required. For a majority of the schools, it was necessary for field staff to set out a measured course. To do so, they used a Rolatape cross-country measuring wheel.

Recruitment and training of field staff

AAHPERD assisted in the recruitment of the five members of the field staff. Qualified individuals had to have a degree in physical education or a related discipline (masters preferred), experience in working with children (preferably in a school setting), familiarity with fitness testing procedures, organizational ability, and tolerance for the give-and-take found in a school setting. An individual had to be available for the full 10-week duration of data collection. Field staff candidates were all female, following a practice established in NCYFS I.

Recruited field staff were sent copies of the study protocol and other materials for review prior to a formal training seminar. The actual training seminar was conducted in Washington, DC, over a three-day period. Day 1 of training was focused on the technical skills required of field staff (e.g., how to administer the tests). Day 2 consisted of supervised application of the skills acquired during Day 1. Trainees were required to administer each of the measures between five and 20 times on a group of six- to nine-year-olds. An individual's errors in measurement technique were corrected and subsequently reviewed by the group. A formal exercise to establish interrater reliability for the skinfold measurements was part of Day 2. During Day 3 a general review was conducted. Consideration of logistic and administrative procedures, feedback on the calibration exercise, and development of consensus on any required changes in procedures were discussed.

Monitoring of the activities and problems of individual field staff members was an important part of data collection. Through a biweekly project newsletter, common problems were discussed, procedures were reviewed, and camaraderie was maintained by sharing anecdotes from the field.

Prepare schools and teachers

Schools required advance notification of all study procedures. Negotiations for school participation began an average of four months prior to data collection. Several weeks before data collection at a school, the details of scheduling, class selections, and teacher responsibilities were worked out with the school's appointed contact person. Teacher responsibilities varied from school to school. The range of responsibilities were to (1) hand out consent forms, (2) prepare children for the distance walk/run, (3) demonstrate tests to the students, (4) assemble the modified pull-up device, (5) record data on score cards, and (6) help maintain order during the walk/run. A schedule signifying when field staff would be at the school was drafted and sent to the contact person for verification prior to staff's arrival. A partially assembled modified pull-up device was sent to the school well in advance. A sit-and-reach box was sent to the first school to be tested in each location.

Consent forms were provided to each school at least two weeks before the start of data collection. The consent forms were packaged by class and marked with each teacher's name. Packets for teachers included a copy of the schedule, a description of specific teacher responsibilities, and copies of all needed instructional materials. Only those teachers requested to perform a specific task received related instructional materials. Efforts to prepare schools for the project staff's arrival worked especially well when a contact person had talked with other members of the school staff and when the school had a centrally coordinated calendar.

Prepare student participants

Students were supplied with advance notice of the testing conditions, which included a mechanism for medical exclusions, the description of the nature of the test items, and a discussion of proper dress for the activities.

Consent forms were sent to the parents of each selected student to explain the data collection procedures and to advise that the student should not participate if (1) the child was limited from doing vigorous physical activity with friends or in school for health reasons, (2) a doctor said that the child was not allowed to take part in normal physical activity because of a recent sickness or injury, or (3) there were other medical reasons why the child could not do the activities involved.

Photograph by Greg Merker

The standard protocol for the bent-knee sit-up requires that the student's arms remain folded across and flat against the chest.

Students consenting to participate in the tests were given an "Exercise Practice Sheet." This sheet explained how to do the sit-and-reach, modified pull-ups, sit-ups, and the distance walk/run. Teachers were asked to review the practice sheets with their students and to demonstrate how to do the tests. The purpose of the practice sheets, demonstrations, and limited student practice was to improve the validity of measurements by removing the effect on performance of nonfamiliarity with proper technique. Teachers were provided with specific instructions on how to convey to students the mental concept of pacing for the mile or half-mile walk/run.

Maintain sample integrity

High participation rates were critical to achieving valid results for the study. In many schools, teachers attempted to maximize participation rates by calling parents to explain the study. Principals and PTA's also advertised and supported the study through their newsletters.

It was equally important to the validity of results that only students from randomly selected classes participate. Interested students sometimes tried to join the study. Occasionally, teachers tried to replace a student with a volunteer or add the "star" athlete to the sample. To ensure the sample's integrity, the field staff regularly checked the identity of participants against the list of students from the randomly selected class sections.

Monitor data collection

Field activities were monitored closely to ensure that field staff and teachers followed the protocol, and that problems were handled promptly. Monitoring was accomplished through telephone contact and on-site visits.

Project administrative staff maintained regular, often daily contact with members of the field staff. This constant contact enabled senior staff to advise on typical problems, such as unprepared class (consent forms not distributed), major disruptions to schedule, initially low participation rates, continuous inclement weather, equipment that was damaged in shipment, difficult questions from a local newspaper or television reporter, and strategies for testing disabled students. Telephone contact also helped to maintain morale and resolve day-to-day living problems for young field staff living, in many cases, far from home. Problems included: not having suitable clothing for the weather; locking keys inside or having a minor accident with a rented car; staying in a hotel too far from the schools or in the wrong part of town, or that lacked exercise facilities; running low on cash; refusal by a hotel to honor a reservation; uncertainty about "allowable expenditures"; and just plain loneliness.

Establish interrater reliability

Interrater reliability on the skinfold measurements was established at two points in time: prior to field work and during field work. During training, interrater reliability was established by having the field staff and two headquarters staff experts measure each of 17, six- to nine-year-old boys and girls. A mean interrater correlation of .96 was obtained for this period. Interrater reliability was reestablished in the field an average of five weeks later by having one of the headquarters experts retest groups of 20 students already tested by a member of the field staff. The mean interrater correlation under field conditions was .99. Such correlations are more than acceptable. Additional information about the reliability of the skinfold data may be found in another article.

Edit and verify all data

Following the collection of survey forms and fitness score cards, several additional quality control steps were taken. While still in an area, field staff reviewed all data for completeness. In many cases, staff were required to return to a school and finish testing a student or to telephone a parent to complete a parent survey.

All surveys and score cards were manually reviewed once they arrived at project headquarters. Those errors which were correctable were corrected. Physical activities reported on the parent or teacher surveys were coded by the same person in all cases, to ensure comparability. All data were then key entered. A 100 percent verification was performed on the keyed data. A random 2 percent check of the verified data established a low error rate of .0002.

Range checks were performed and any data falling outside of acceptable ranges were scrutinized. In many cases, corrections were made to erroneous scores by rechecking original score cards.

The survey data were also checked for internal consistency and range. For example, all fitness values falling outside a normal distribution were checked for accuracy. Some consistency checks were made (e.g., checking data on skinfolds against height and weight).

Student confidentiality was assured by not recording student names. Schools and locations were given a numerical code, but provisions were made to protect their anonymity.

Summary and conclusions

Although it is difficult to assess the overall affects of the quality control techniques used in NCYFS I and II, the techniques used adhered to the most rigorous standards for testing the fitness of children in the United States to date. The documentation of these quality control methods should allow users of the data from this study to focus on the meaning and implications of the results rather than on questions of how the data were collected.

Sample Design

Michael T. Errecart □ Michael Svilar □ James G. Ross
Robert S. Gold □ Pedro J. Saavedra

The NCYFS II was designed to provide reliable data describing the characteristics of first through fourth graders, by age/sex and grade/sex groupings.

In the last 30 years, only six studies have used a nationally representative sample to create physical fitness norms for children and youth. Only two of these studies included children under age 10.

The results from mass-testing programs, despite testing millions of children over the years, do not necessarily represent the fitness levels of the nation's children and youth. Program participants typically are not balanced by region, grade, or sex. Moreover, there is usually a strong element of self-selection by participants. The National Children and Youth Fitness Studies (NCYFS I and II) have been designed to eliminate these problems and to create truly representative national fitness norms and physical activity profiles.

The NCYFS studies were not programs attempting to improve the fitness of participants, but research efforts designed to describe the fitness and profile the physical activity habits of the nation's youth. NCYFS II, like NCYFS I, studied children selected according to rigorous, nonbiased, and mathematically-based rules. The selection process was structured to ensure that the sample would represent the various regions of the country, and include both urban and nonurban areas. Within this frame, participants were selected randomly to avoid biasing the results. The study was designed to provide reliable data describing the characteristics of first through fourth graders, by age/sex and grade/sex groupings. It was not designed to provide estimates by region, state, or level of urbanization.

The sample design was reviewed by the National Center for Health Statistics, which is the agency of the U.S. Public Health Service responsible for most major national health surveys.

Determining sample sizes

In developing complex sample designs, various trade-offs must be made to balance the cost of the survey against the level of accuracy with which national estimates can be made. In most cases, the trade-off is made more difficult because the effects of various cost-saving measures on the accuracy of results is unknown. NCYFS II, however, benefited from the experience of NCYFS I in that the efficiency of the NCYFS I design was known for a slightly older age group (5th graders) and these results provided key parameters for developing the NCYFS II sample.

The desired sample size was initially computed based on the use of a simple random sample to meet established precision criteria. This basic estimate of sample size was then increased by about one-third to compensate for the expected loss in efficiency due to concentrating the sample in a relatively small number of schools. The costs savings due to concentrating the sample more than made up for the cost of adding a few more schools.

The NCYFS II design supports accurate national-level estimates of fitness norms by grade and sex. Sample estimates are accurate to within five percentile points with 95 percent confidence. In other words, were this study repeated over and over, 95 percent of the time the estimate of a given percentile (e.g., 29 sit-ups as the 50th percentile for 9-year-old boys) would be wrong by no more than five percentile points (e.g. 29 sit-ups would almost always be the value of some percentile in the 45-55 percentile range). In fact, 90 percent of the time 29 sit-ups would be the estimated value for the 48th to 52nd percentile.

The desired sample size was also adjusted to compensate for the expected rate of nonparticipation. Based on NCYFS I, a very high rate of participation was expected; therefore, it was assumed that only six percent of the sample would be

Exhibit 1. 25 Randomly Selected Locations (Counties) in the NCYFS II National Sample

lost to attrition in NCYFS II.

As a result of these considerations, a target sample size of 50 classes of average size at each grade level was desired. Plans were also developed for adding and combining classes when class sizes were too small or when single-sex situations were encountered.

Structure of the sample

The sample represents proportionally the various regions of the United States and both urban and rural settings. Since research shows that environmental factors and regional differences influence activity patterns and fitness levels, representativeness was ensured by controlling for these factors in the selection process. With our sampling method, any possible sample would appropriately reflect geographic regions and urbanization factors.

The sample design was used to divide the country into 25 nonoverlapping geographic areas. Twelve of the 25 areas consisted of the 60 largest Standard Metropolitan Statistical Areas (urban strata). The 60 SMSA's were grouped together based on geographic proximity so that the resulting 12 groups were approximately equal in population. For example, those SMSAs represented in the group of 60 which were located in Georgia, Florida, and Alabama were grouped together; another group consisted of the Texas and Louisiana SMSA's. The 12 urban groups accounted for approximately 46 percent of the population.

The remaining 13 areas consisted of smaller SMSAs and all remaining counties (the nonurban strata). In forming these groups, Primary Sampling Units (PSUs) were created by grouping adjacent counties so that the total populations in each grouping were approximately equal. More than 3,000 counties were grouped together manually to create 1,172 PSUs. The PSUs were assigned in such a way that each group represented a compact area of the country and so that the groups had approximately equal populations.

Selecting locations

One SMSA was selected at random from each of the 12 urban groups and from each of the 13 nonurban groups. The chance of an area being selected was proportional to the size of the area relative to other areas. In many cases, a selected area consisted of several counties or other political subdivisions. In these cases, we selected one county from within the PSU with the chance of selection being proportional to county size. The resultant sample included large urban centers, such as New York City, Chicago, and Los Angeles, as well as thinly populated, rural areas such as Lucas, Iowa and Gage, Nebraska (Exhibit 1).

Selecting schools

The grade structures of schools in the early elementary years (grades 1-4) are much more homogeneous than in the later years when school structures tend to become departmentalized. A comprehensive listing of all public and private schools offering education at any combination of grades 1, 2, 3, or 4 in each selected county was obtained. The list was analyzed and schools not offering at least

one class at each grade level were linked to other schools. Following this procedure, two schools were then selected randomly with the chance of selection being proportional to the estimated average grade size of the school. This procedure resulted in a sample that included at least two classrooms from at least two different schools for each county selected for the study.

Selecting classes and students

One class was selected at random at each grade level of interest in the selected schools. Each class at a given grade level had an equal chance of being selected. Students were generally selected as members of a homeroom; i.e., an intact grouping of a cross-section of students who remained together for most of their subjects. All students in selected classrooms were invited to participate.

In some cases, the estimates of the numbers of students at a grade level proved to be inaccurate. In a few instances, a second class section was drawn to provide a sufficient number of students for testing. In one instance, a school no longer had a fourth grade because of a recent reorganization. In this case, an additional school was drawn randomly to supplement the sample.

Participation rates

The final sample consisted of 57 schools in 19 states. Most locations included two schools; seven had three schools. Only one school from our original sample refused to participate in the study. The final sample of classes contained 4,853 students (2,435 boys and 2,418 girls) of whom 96.4 percent participated, a participation rate about two percent higher than expected. Given such a high participation rate, the impact of nonparticipation on the final results is negligible. The participation level is consistent with NCYFS I, which attained its highest rates (93-94%) at fifth and sixth grades (Exhibit 2).

A written survey was completed by 94.5 percent of the parents of participating students. In addition, almost 40 percent of the parents of nonparticipating students completed the parent survey. This strong participation by parents enabled us the linkage of student and parent data for almost 90 percent of the sample (Exhibit 3).

Weighting

NCYFS II used a self-weighting sampling design to maximize the efficiency of national estimates. This means that each student in the United States had approximately the same chance of being selected. This self-weighting property is really an ideal that is typically compromised due to various factors: nonparticipation, errors in estimates at various stages of selection, and the use of replacements. Such factors cause the probabilities of selection to vary from student to student, requiring that weights be computed to compensate for these differences.

The weights initially developed reflected the chance of selection of the PSU, county, school, and class. They were later adjusted to reflect the small level of nonparticipation. In addition, special estimates were made at the county level of the total population of boys and girls ages six to nine. These estimates were compared to the latest decennial U.S. Census information and adjustments made to bring the data into agreement.

Summary and conclusions

The NCYFS II sample was designed to allow estimation of national health-related fitness norms for first through fourth graders by sex. The sample consisted of 4,853 students from 57 schools in 19 states representing all areas of the country, including both urban and nonurban areas. The sampling method was designed to offer every child enrolled in public or private schools in the nation an approximately equal chance of participating in the study.

Participation rates were exemplary: only one school dropped out of the study (it was replaced); more than 96 percent of the student sample participated; and more than 94 percent of the parents of participating students completed a written survey.

Thus, the twin factors of a sound sample design and high participation rates provide the basis for making reliable estimates of national fitness norms.

Exhibit 2. Student Sample Sizes and Participation Rates by Grade and Sex

	Boys			Girls		
Grade	Selected	Participants	Percent	Selected	Participants	Percent
1	615	598	97.2	565	536	94.6
2	603	589	97.7	596	583	97.8
3	603	578	95.9	597	572	95.8
4	614	585	95.2	660	637	96.1
1-4	2,435	2,350	96.5	2,418	2,328	96.3

Exhibit 3. Parent Sample Sizes and Participation Rates by Grade and Sex of Child

	Boys			Girls		
Grade	Eligible Parents	Participants	Percent	Eligible Parents	Participants	Percent
1	590	563	94.1	536	511	95.4
2	589	560	95.6	583	552	94.7
3	576	556	96.2	572	544	95.1
4	585	548	93.7	637	601	91.1
1-4	2,350	2,227	94.8	2,328	2,208	94.3

New Health-Related Fitness Norms

James G. Ross □ Russell R. Pate □ Lisa A. Delpy
Robert S. Gold □ Michael Svilar

To ensure that the resulting fitness norms would be accurate and representative of the nation's youth, data were collected from public, private, and parochial schools across the nation.

It has recently been argued that health-related physical fitness should be assessed by comparison with criterion-referenced standards rather than population-based percentile norms. Such standards would be established by determining the fitness levels needed to maintain acceptable levels of functional capacities and to minimize risk of developing diseases associated with physical inactivity and/or low levels of fitness. However, widely accepted standards have not been arrived at. Population-based norms continue to play the dominant role in the interpretation of the fitness of individuals and groups. Population-based norms will always be a critical tool in describing and monitoring changes in the fitness status of American youth.

NCYFS II Norms by Age for the Triceps Skinfold (in millimeters)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	5	5	5	5	5	6	6	6
95	6	5	6	6	7	7	7	7
90	6	6	6	6	8	7	8	8
85	7	7	7	7	8	8	8	9
80	7	7	7	7	9	8	9	10
75	7	7	7	8	9	9	9	10
70	7	7	8	8	9	9	10	11
65	8	8	8	9	10	10	10	11
60	8	8	8	10	10	10	11	12
55	8	8	9	10	11	11	12	12
50	8	9	9	10	11	11	12	13
45	9	9	10	11	12	12	13	14
40	9	10	10	12	12	12	14	14
35	10	10	11	13	13	13	15	15
30	10	11	12	14	13	13	16	16
25	10	11	13	15	14	14	17	18
20	11	12	14	16	14	15	18	19
15	12	14	15	18	15	17	19	21
10	13	16	19	21	17	19	21	22
5	16	20	23	23	20	22	25	25

Population-based norms can serve several useful purposes. First, such norms constitute a description of the current status of a population in terms of the variables observed. Second, when the measurements are readministered at periodic intervals, the resulting normative data provide a basis for tracking change in the population over time. Third, valid normative data can be used as a basis for comparison of selected subgroups with the population at large. And, fourth, the status of an individual can be assessed by comparing his or her status with that of the population.

This article presents the first nationally representative health-related physical fitness norms for six- to nine-year-olds. The statistical procedures used in developing

these norms and the relationship of this normative study to prior studies are also discussed.

Prior normative studies

In the past 30 years, six studies have produced fitness norms on nationally representative samples. The first three studies, in 1957, 1965, and 1975, produced norms for 10- to 17-year-olds on the AAHPERD Youth Fitness Test (YFT), which was primarily a test of motor performance. In 1984, the National Children and Youth Fitness Study (NCYFS I) produced the first nationally representative norms for 10- to 18-year-olds on the AAHPERD Health Related Physical Fitness Test (HRPFT) (Ross, Dotson, Gilbert & Katz, 1985). In 1986, new normative data were gathered on six- to 17-year-olds for the YFT and other test items (Reiff, 1986). Most recently, NCYFS II developed the first nationally representative norms on the HRPFT for six- to nine-year-olds.

The NCYFS studies are distinguished by how data were collected. These studies used as their sampling frame all school children in the nation. They included not only public schools, but also private and parochial schools. Data for NCYFS I and II were gathered by a small, traveling field staff of trained professionals, not by a large number of physical education teachers. These changes in data collection and sampling procedures were designed to ensure that the resulting norms would be accurate and representative of the nation's youth.

Development of fitness norms

NCYFS II developed normative data on the four test items from the AAHPERD HRPFT (triceps and subscapular skinfolds, sit-and-reach test, bent-knee sit-ups, and mile walk/run) (AAHPERD, 1980). A third skinfold site (medial calf) was added as an alternative or supplement to the subscapular. A modified pull-up was added to provide a gender-free alternative to customary tests of upper body strength. Finally, recognizing the difficulty of asking young, untrained children with relatively short attention spans to walk/run a mile, a half mile walk/run was added for children under the age of eight.

The norms were constructed through analysis of 4,678 cases distributed approximately evenly among grades one through four. Data were available on all five items (skinfolds, sit-and-reach, sit-ups, modified pull-ups, and distance walk/run) for approximately 95

NCYFS II Norms by Age for the Subscapular Skinfold (in millimeters)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	4	4	4	4	4	4	4	4
95	4	4	4	4	4	4	5	5
90	4	4	4	5	5	5	5	5
85	4	5	5	5	5	5	5	5
80	5	5	5	5	5	5	5	6
75	5	5	5	5	5	5	6	6
70	5	5	5	5	5	5	6	6
65	5	5	5	6	6	6	6	6
60	5	5	5	6	6	6	6	7
55	5	5	6	6	6	6	7	7
50	5	5	6	6	6	6	7	8
45	5	6	6	7	6	7	7	8
40	6	6	6	7	7	7	8	9
35	6	6	6	7	7	7	8	9
30	6	6	7	8	7	8	9	10
25	6	7	7	9	8	9	10	12
20	7	7	8	10	8	10	12	15
15	7	8	10	12	10	11	15	17
10	8	10	14	15	12	13	17	21
5	12	16	19	20	16	19	21	25

NCYFS II Norms by Age for the Medial Calf Skinfold (in millimeters)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	4	4	4	4	5	5	5	5
95	5	5	5	5	6	6	6	7
90	5	5	5	5	7	7	7	7
85	6	6	6	6	8	7	8	8
80	6	6	6	7	8	8	8	9
75	6	7	7	7	8	8	9	10
70	7	7	7	8	9	9	10	10
65	7	7	7	8	9	9	10	11
60	7	7	8	9	10	10	11	11
55	7	8	8	10	10	10	11	12
50	8	8	9	10	10	11	12	13
45	8	9	10	11	11	12	13	14
40	9	9	10	11	11	12	13	14
35	9	10	11	12	12	13	14	15
30	10	11	11	13	13	13	15	16
25	10	11	12	14	13	15	16	17
20	11	12	14	15	14	15	18	18
15	12	14	15	17	16	17	19	20
10	13	16	19	20	17	18	21	22
5	17	19	21	24	20	21	24	27

percent of participants. For the other five percent, missing scores were imputed using a regression procedure, when possible, after searching for the best possible equation to estimate the missing scores; other missing scores were imputed using mean scores. Most of the cases with missing scores had completed all tests except the distance walk/run.

Data were analyzed using a Statistical Analysis System (SAS) procedure called UNIVARIATE. The UNIVARIATE procedure allows the generation of means, standard deviations, and cumulative frequencies, among other statistics, using weighted data. From the cumulative frequencies, every fifth percentile was extracted to create the normative tables, which are reported by age and sex.

NCYFS II Norms by Age for the Sum of Triceps and Medial Calf Skinfolds (in millimeters)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	9	9	9	9	11	11	11	12
95	11	11	11	11	13	13	14	14
90	12	12	12	12	15	15	15	16
85	12	13	13	13	16	16	16	18
80	13	13	13	14	17	17	18	19
75	14	14	14	15	18	18	19	20
70	14	14	15	16	18	18	20	21
65	15	15	15	18	19	19	21	22
60	15	16	17	18	20	20	22	23
55	16	16	17	19	21	21	23	25
50	16	17	18	21	21	22	24	26
45	17	18	19	22	22	23	26	27
40	17	19	20	23	23	24	27	29
35	18	20	21	25	24	25	29	30
30	20	21	23	27	25	26	31	32
25	20	22	24	29	27	28	33	35
20	22	24	27	31	28	31	35	37
15	23	27	31	35	30	33	38	41
10	27	32	37	40	33	37	43	45
5	33	39	44	47	38	43	49	52

Using the norms

The tables in this article present norms on the following items broken down by age and sex: (1) Triceps skinfold; (2) Subscapular skinfold; (3) Medial calf skinfold; (4) Sum of triceps and medial calf skinfolds; (5) Sit-and-reach test; (6) Modified pull-ups; (7) Bent-knee sit-ups; (8) Mile walk/run (for children age eight and over); and (9) Half mile walk/run (for children under age eight).

These population-based health-related fitness norms can be ap-

NCYFS II Norms by Age for the Sit-and-Reach (in inches)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	17.5	18.0	18.0	17.5	18.5	18.0	19.0	19.0
95	16.5	16.5	16.5	16.0	17.5	17.5	17.5	18.0
90	16.0	16.0	16.0	15.5	16.5	17.0	17.0	17.0
85	15.5	16.0	15.5	15.0	16.0	16.5	16.5	16.5
80	15.0	15.5	15.0	14.5	16.0	16.0	16.0	16.0
75	15.0	15.0	14.5	14.5	15.5	16.0	16.0	16.0
70	14.5	14.5	14.5	14.0	15.0	15.5	15.5	15.5
65	14.0	14.0	14.0	14.0	15.0	15.0	15.0	15.0
60	14.0	14.0	14.0	13.5	15.0	15.0	15.0	15.0
55	13.5	13.5	13.5	13.0	14.5	15.0	14.5	14.5
50	13.5	13.5	13.5	13.0	14.0	14.5	14.0	14.0
45	13.0	13.0	13.0	12.5	14.0	14.5	14.0	14.0
40	12.5	12.5	12.5	12.0	14.0	14.0	13.5	14.0
35	12.5	12.5	12.5	12.0	13.5	14.0	13.5	13.5
30	12.0	12.0	12.0	11.5	13.0	13.5	13.0	13.0
25	12.0	11.5	11.5	11.0	12.5	13.0	12.5	12.5
20	11.5	11.5	11.0	10.5	12.0	12.5	12.0	12.0
15	11.0	11.0	10.5	10.0	12.0	12.0	11.5	11.5
10	10.5	10.0	9.5	9.5	11.5	11.5	11.0	11.0
5	10.0	9.0	8.5	8.0	10.5	10.5	10.0	9.0

Note: The NCYFS set the "0" point at 12 inches, whereas the 1980 AAHPERD norms employed a "0" point of 23 cm. To translate the NCYFS inches into cm. and to adjust the "0" point to 23 cm., the following formula may be applied to the NCYFS norms: score in cm. = (score in inches × 2.54) − 7.48.

propriately used by practitioners in several ways. First, the norms allow the status of any group of children to be related to that of "typical" American youngsters of the same age and sex. For example, a teacher might express the status of a group of students in terms of the average percentile score for each test item. Such a practice can aid teachers, parents, and school administrators in understanding how their youngsters compare with children nationally.

Second, percentile norms can be used as a general guide in assigning qualitative ratings to fitness test performances. However, criterion-referenced standards are more appropriate for this purpose and should be established and used in making these judgments. In lieu of these standards, designated percentile "cut points" can be useful

NCYFS II Norms by Age for the Modified Pull-Ups (number completed)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	25	27	38	35	24	27	25	30
95	18	20	21	25	17	20	20	20
90	15	19	20	20	13	16	17	17
85	12	15	17	20	11	14	14	15
80	11	13	15	17	10	12	12	13
75	10	13	14	15	9	11	11	12
70	9	12	13	14	9	10	11	11
65	8	11	12	13	7	9	10	10
60	7	10	11	12	7	8	9	10
55	7	9	10	11	6	8	9	9
50	6	8	10	10	6	7	8	9
45	6	8	9	10	5	7	7	8
40	5	7	8	9	5	6	6	7
35	5	6	8	8	4	5	6	6
30	4	5	7	7	4	4	5	5
25	3	4	6	6	3	4	4	4
20	3	4	5	5	2	3	4	4
15	2	3	4	4	1	2	3	2
10	1	1	3	3	0	1	1	1
5	0	0	1	2	0	0	0	0

Photograph by James F. Kirby

for identifying test scores that might be "acceptable" or "unacceptable." Selecting these percentile cut points is admittedly an arbitrary and somewhat hazardous process. However, for the time being, it is suggested that test scores ranking below the 25th percentile be considered "unacceptable." Scores above this level may not be optimal, but may be at least marginally acceptable from a health perspective.

Finally, norms can be helpful in interpreting for students and parents the significance of a change in test performance. For example, a seven-year-old boy's improvement from 19 to 27 on the one minute timed sit-up may become more meaningful if it is noted that this change moved the youngster from the 30th to the 70th percentile. When lengthy periods intervene between pretests and posttests, caution must be applied in such uses of the norms because aging can change performance on fitness tests. Thus, judgments about the significance of a change in test performance should be made by examining both absolute test scores and percentile ranks.

NCYFS II Norms by Age for the Timed Bent-Knee Sit-Ups (number in 60 seconds)

	Age							
	Boys				Girls			
Percentile	6	7	8	9	6	7	8	9
99	36	42	43	48	36	40	44	43
95	31	35	38	42	31	35	37	39
90	28	32	35	39	28	33	34	36
85	26	30	33	36	26	30	32	34
80	25	29	32	35	24	28	30	32
75	24	28	30	33	23	27	29	31
70	22	27	29	32	22	26	28	30
65	21	26	28	31	21	24	27	29
60	20	25	27	30	20	23	26	28
55	19	24	26	29	19	22	25	26
50	19	23	26	28	18	21	25	26
45	18	22	25	27	17	21	24	25
40	17	21	24	26	17	20	23	24
35	16	20	23	25	16	19	21	23
30	15	19	21	24	15	17	20	22
25	14	18	20	23	14	16	19	21
20	12	16	19	22	12	15	17	19
15	11	14	17	19	10	13	16	17
10	9	12	15	16	6	11	13	15
5	4	7	11	13	1	7	9	10

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Ross, J. G., Dotson, C. O., Gilbert, G. G., & Katz, S. J. (1985). New standards for fitness measurement. *Journal of Physical Education, Recreation & Dance, 56* (1): 62-66.

NCYFS II Norms by Age for the Distance Walk/Run (in minutes and seconds)

	Age							
	Boys				Girls			
	Half Mile		Mile		Half Mile		Mile	
Percentile	6	7	8	9	6	7	8	9
99	3:53	3:34	7:42	7:31	4:05	4:03	8:18	8:06
95	4:15	3:56	8:18	7:54	4:29	4:18	9:14	8:41
90	4:27	4:11	8:46	8:10	4:46	4:32	9:39	9:08
85	4:35	4:22	9:02	8:33	4:57	4:38	9:55	9:26
80	4:45	4:28	9:19	8:48	5:07	4:46	10:08	9:40
75	4:52	4:33	9:29	9:00	5:13	4:54	10:23	9:50
70	4:59	4:40	9:40	9:13	5:20	5:00	10:35	10:15
65	5:04	4:46	9:52	9:29	5:25	5:06	10:46	10:31
60	5:10	4:50	10:04	9:44	5:31	5:11	10:59	10:41
55	5:17	4:54	10:16	9:58	5:39	5:18	11:14	10:56
50	5:23	5:00	10:39	10:10	5:44	5:25	11:32	11:13
45	5:28	5:05	11:00	10:27	5:49	5:32	11:46	11:30
40	5:33	5:11	11:14	10:41	5:55	5:39	12:03	11:46
35	5:41	5:17	11:30	10:59	6:00	5:46	12:14	12:09
30	5:50	5:28	11:51	11:16	6:07	5:55	12:37	12:26
25	5:58	5:35	12:14	11:44	6:14	6:01	12:59	12:45
20	6:09	5:46	12:39	12:02	6:27	6:10	13:26	13:13
15	6:21	6:06	13:16	12:46	6:39	6:20	14:18	13:44
10	6:40	6:20	14:05	13:37	6:51	6:38	14:48	14:31
5	7:15	6:50	15:24	15:15	7:16	7:09	16:35	15:40

The Modified Pull-Up Test

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By taking body weight into consideration, the modified pull-up test avoids the zero score problem associated with the more traditional pull-up, chin-up, and flexed-arm hang test.

Upper body muscular strength has long been considered an important component of physical fitness, and measures of this component are included in most of the field test batteries of physical fitness implemented over the past 50 years. While various tests of upper body strength have been used in different batteries, the most commonly used have been the pull-up (palms away from the body) for boys and the flexed-arm hang for girls. These items are included in the AAHPERD Youth Fitness Test (YFT). (Hunsicker & Reiff, 1976). The chin-up test (palms toward the body) was administered to both boys and girls in the first National Children and Youth Fitness Study (NCYFS I). However, in NCYFS II a modified pull-up test was used with both boys and girls. In this article, the modified pull-up test is described, the rationale for its selection is explained, and what was learned from using it in NCYFS II is discussed.

Problems with pull-up, chin-up, and flexed arm hang tests

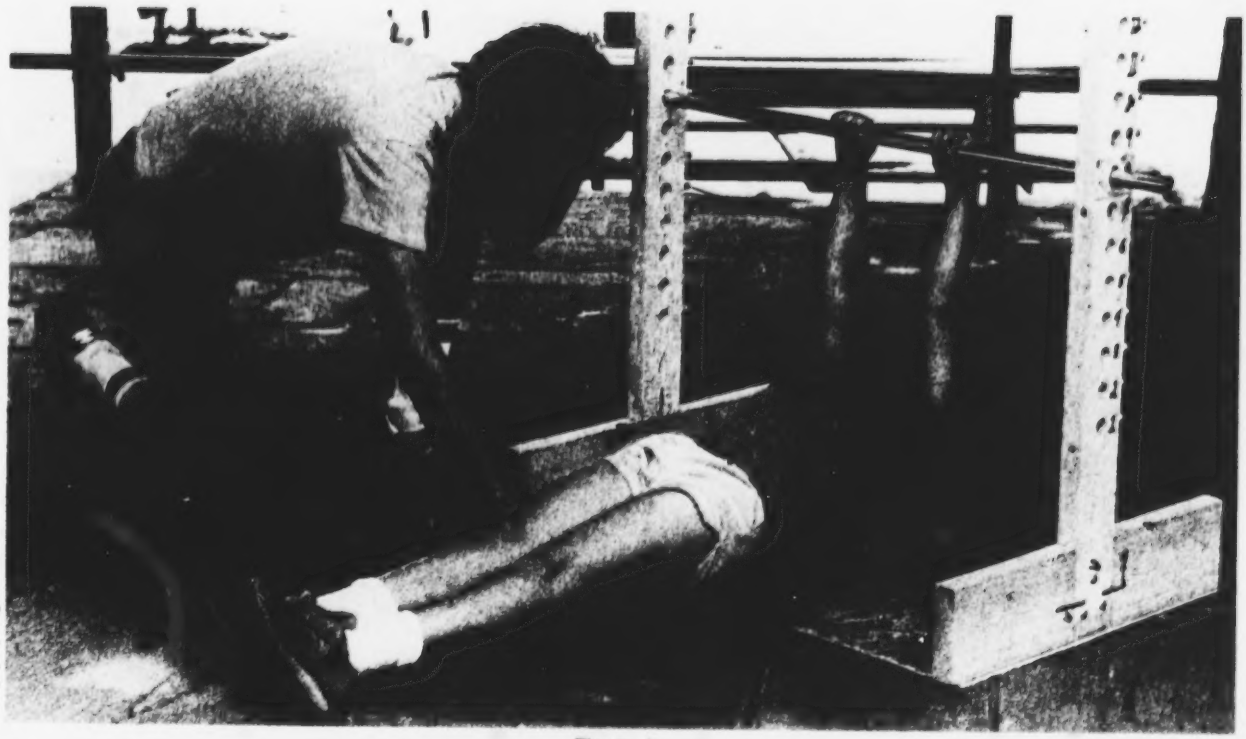
Experience has revealed certain problems with the traditional pull-up, chin-up, and flexed-arm hang tests. First, and perhaps most important, performance on these test items is markedly confounded by body weight. With the chin-up, pull-up, and flexed-arm hang tests, the *entire* body weight must be overcome and, as has been documented in prior normative studies, many children cannot accomplish this task. In NCYFS I, 30 percent of boys in the 10-11 year age groups failed to perform a single chin-up. For girls, at least 60 percent of subjects in all age groups between 10 and 18 years scored zero on the chin-up test. (Ross, Dotson, Gilbert & Katz, 1985). The YFT norms for the pull-up indicate that 25-30 percent of boys in the nine-12 year age groups score zero. Use of the flexed-arm hang reduces, but does not eliminate, the zero score problem. The YFT norms indicate that about 10 percent of girls across the nine-17 age range score zero on the flexed-arm hang.

It seems clear that the pull-up, chin-up, and flexed-arm hang tests provide very poor measurement sensitivity at the low end of the range of values for upper body strength. From an evaluation standpoint, this is an obvious weakness because it implies, fallaciously, that a large percentage of youngsters have "zero" strength. This problem may also reduce student acceptance of the test and reduce the likelihood of achieving important behavioral objectives of fitness testing. No one likes to take a test which he or she will utterly fail.

The modified pull-up

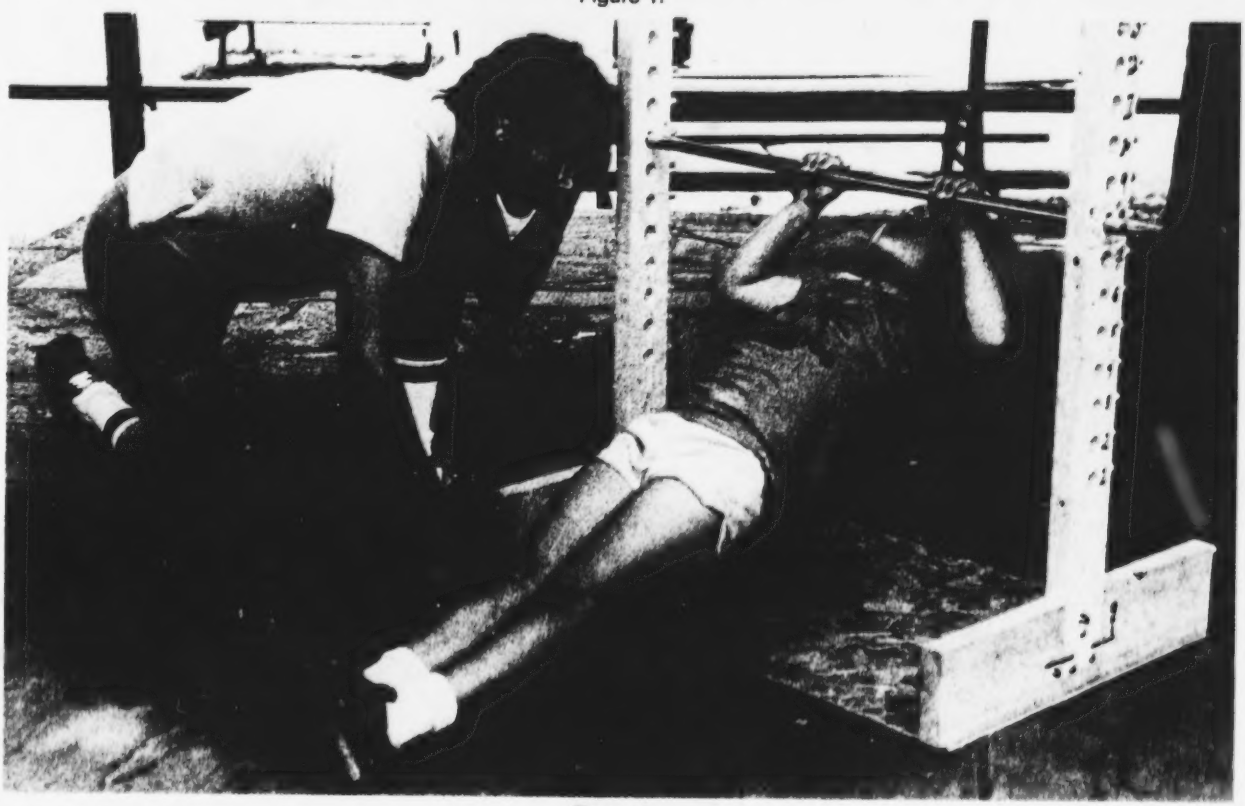
Due to the problems cited above, a better test of upper body muscular strength/endurance was sought for use in NCYFS II. The intent was to find a test that would overcome the zero-score problem and that would be well-accepted by young children. After considering several options, the "modified pull-up" test was selected. This test is similar to the "desk pull-up" used in the Vermont Physical Fitness Test. The major features of the modified pull-up are:

- The child is positioned on his/her back with the shoulders directly below a bar that is set at a height one or two inches beyond the child's reach.
- An elastic band is suspended across the uprights parallel to and about seven to eight inches below the bar.
- As depicted in Figure 1, in the "start" or "down" position, the child's buttocks are off the floor, the arms and legs are straight, and only the heels are in contact with the floor.



Photograph by Greg Merker

Figure 1.



Photograph by Greg Merker

Figure 2.

- An overhand grip (palm away from body) is used and thumbs are placed around the bar.
- A pull-up is completed when the chin is hooked over the elastic band (see Figure 2). The movement should be accomplished using only the arms and the body must be kept straight.
- The child executes as many pull-ups as possible, keeping the hips and knees extended through each attempt.

Experience with the modified pull-up

The results on NCYFS II indicate that the modified pull-up test overcomes the zero score problem discussed above. As indicated in the norm tables for this item, only five percent or less of children in the six-nine year age groups were unable to perform one modified pull-up. The median score for girls ranged from six to nine and for boys from six to 10. These data indicate that most youngsters could perform the test and that a reasonable range of scores was observed.

The test involves a movement that is somewhat novel for many young children. However, it was found that virtually all youngsters could learn to perform the test with a modest amount of orientation. To perform the test properly, the child must maintain the hips in an extended position as the pull-up is executed. Children could develop a "feel" for this position by first practicing the reverse push-up which requires maintenance of the same "hips extended" position. Also, phrases such as, "keep your body straight as an arrow" and "pretend you are a torpedo" were helpful in communicating this concept to the children.

In NCYFS II, a specially constructed test apparatus depicted in Figures 1 and 2 was used. However, any low pull-up bar that allows for adjustment of height would suffice. The apparatus used in NCYFS II could be constructed for $15 to $35.

Conclusions and recommendations

The modified pull-up is an improvement over the more traditional pull-up, chin-up, and flexed-arm hang tests. This test minimizes the zero score problem and yields a reasonable range of scores for both boys and girls. Consequently, the modified pull-up can be used to avoid sex-specificity in field measurement of upper body strength.

NCYFS II is the first project in which the modified pull-up has been used on a large scale; therefore, its further study is needed. Validation against criterion measures of upper body muscular strength and endurance are required. It should also be compared with other field tests in terms of validity and reliability. In addition, the test should be normed in a nationally representative sample of older children and youth (ages 10-18).

References

Hunsicker, P. & Reiff, G. (1976). *AAHPERD youth fitness test manual.* Washington, DC: AAHPERD Publications.

Ross, J. G., Dotson, C. O., Gilbert, G. G., & Katz, S. J. (1985). New standards for fitness measurement. *Journal of Physical Education, Recreation & Dance, 56*(1): 62-66.

Photograph by Greg Merker

Changes in the Body Composition of Children

James G. Ross □ Russell R. Pate □ Timothy G. Lohman
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Skinfolds are a practical index of body composition or relative fatness/leanness which provide a more accurate estimate of body fatness than simple weight, height, and various ratios of these two measurements.

Changes in those aspects of the physical fitness of children that pertain to health are matters of both scientific and practical concern. Changes up or down imply alterations in the capacity to work and play, adjustments to the quality of life, and shifts in vulnerability to various health problems.

Documenting changes in the fitness of children is difficult. In the three decades since the first study of the fitness of a nationally representative sample of U.S. children was conducted in 1957, the measures of fitness have changed to reflect different aspects of fitness. Those measures of fitness that have remained the same relate to *motor performance* rather than to *health*. The only health-related fitness indices for which valid, national data are available to represent several points in time are anthropometric measurements, including measures of skinfold thickness.

Skinfolds are a practical index of body composition, or relative fatness/leanness. They provide a more accurate estimate of body fatness than simple weight, height, and various ratios of these two measurements. Body composition may be viewed as an important concurrent indicator of a child's health-related fitness.

The National Children and Youth Fitness Study (NCYFS I) provided evidence of increased skinfolds in 10- to 18-year-olds from the 1960s to the 1980s (Pate, Ross, Dotson, & Gilbert, 1985). Recent evidence has also been presented to show increases in fatness and obesity among six- to nine-year-olds over a 15-year period from the early 1960s to the late 1970s (Gortmaker, Dietz, Sobol & Wehler, 1987). More recently, skinfold data were collected from a nationally representative sample of six- to nine-year-olds in NCYFS II. Before determining the significance of observed changes in skinfolds, a series of questions must be answered: Were methods of data collection comparable? How reliable are the NCYFS II data? Are there alternative explanations of any apparent findings? What do the skinfold data show? This article addresses these questions and points out future directions for examining changes in body fatness in children.

Sources of skinfold data

Skinfold measurements at two sites, the triceps and subscapular, have been taken on nationally representative samples of six- to nine-year-olds on four occasions in the last 23 years. The first three times, they were collected by the National Center for Health Statistics (NCHS), once in 1963-1965 and twice in the 1970s. They were collected for the fourth time in 1986, in conjunction with the NCYFS II. This article compares data for triceps and subscapular skinfolds from an NCHS survey, the National Health Examination Survey

II (NHES II), and NCYFS II to determine whether there have been changes in skinfold thicknesses over a period of over 20 years, from the 1960s to the 1980s.

Comparability in technique

Certain procedures for measuring skinfolds must remain the same for results across studies to be considered comparable. NCYFS II sought to maintain comparability with NHES II (Johnson, Hamill, & Lemeshow, 1972) on certain critical procedures:

- *Instrumentation*—The Lange skinfold caliper was used. This instrument is designed to exert a constant pressure of 10 grams/mm(2) throughout the range of jaw openings. Before each testing session, the calibration of the caliper was checked and recorded using a Lange calibration block at each 5mm interval from five through 50. Calipers were kept in use as long as they remained within ±1mm at each interval. No adjustments were made in readings to reflect such minor fluctuations in caliper performance.
- *Testing protocol*—Procedures for identifying landmarks, marking the skinfold site, and taking the actual skinfold were comparable.
- *Checks on tester reliability*—Staff

Photograph by Greg Merker

Exhibit 1. Comparison of Selected Skinfold Means by Age and Sex* (NHES II/1960s vs NCYFS II/1980s)

Age	Triceps				Subscapula			
	Boys		Girls		Boys		Girls	
	NHES II 1960's	NCYFS II 1980's	NHES II 1960's	NCYFS II 1980's	NHES II 1960's	NCYFS II 1980's	NHES II 1960's	NCYFS II 1980's
6	8.1 ± 2.79 (575)	9.34 ± 3.60 (465)	9.7 ± 3.39 (536)	11.81 ± 4.01 (463)	4.9 ± 1.83 (575)	6.31 ± 3.63 (465)	5.5 ± 2.67 (536)	7.43 ± 3.96 (463)
7	8.4 ± 3.17 (632)	10.10 ± 4.54 (567)	10.4 ± 3.61 (609)	12.30 ± 4.85 (561)	5.1 ± 2.46 (632)	6.63 ± 3.61 (567)	6.1 ± 3.04 (609)	8.02 ± 5.01 (561)
8	9.0 ± 3.77 (618)	10.92 ± 5.35 (560)	11.4 ± 4.43 (613)	13.60 ± 5.51 (569)	5.5 ± 2.90 (618)	7.51 ± 5.19 (560)	6.9 ± 3.93 (613)	9.28 ± 6.16 (569)
9	10.0 ± 4.96 (603)	12.14 ± 5.77 (578)	12.3 ± 4.84 (581)	14.55 ± 6.36 (597)	6.2 ± 3.86 (603)	8.38 ± 5.69 (578)	7.8 ± 4.93 (581)	10.34 ± 7.02 (597)

All differences between NHES/1960s and NCYFS II/1980s are significant at the .005 level in a one-tailed t-test.

Photograph by Greg Merker

were extensively trained and the reliability of measurements established both at training and under field conditions by comparing the tester's measurements with those of a "standard."

- *Sample sizes*—Both studies used valid national probability samples of children. The sample sizes of six- to nine-year-olds for NHES II (N = 4,767) and NCYFS II (N = 4,380) were comparable.
- *Student participation*—Both studies achieved 96 percent participation rates by children.

There were two minor differences between the NHES II and NCYFS II in how skinfolds were taken or recorded. The first difference was the number of measurements taken at each site. NHES II took only two measurements at each site, with a third measurement taken to resolve discrepancies. In NCYFS II, three measurements were typically taken at each site, with the median score recorded. However, the three measurements in NCYFS II had to fall within 2mm of each other to be considered reliable. If, after three measurements, the scores were not within 2mm, as occasionally happened with obese children, up to seven measurements were taken at each site until three consecutive measurements fell within 2mm, with the median recorded. The second difference was that the NHES II recorded skinfold measurements to the nearest .5mm, whereas NCYFS II rounded to the nearest full 1mm. The procedures in NHES II and NCYFS II seem sufficiently comparable to permit comparison of findings.

Reliability of measurements

To be confident that any measured differences in both mean and median skinfolds represent a real change, there must be reasonable assurances that data are both reliable and accurate. Toward this end, data collection procedures in NCYFS II were comparable to those in the NCHS studies. Reliability of the tester's measurement technique was established both during training and under field conditions by measuring the consistency of measurements of testers against each other and in comparison to a standard.

Tester reliability was assessed by calculating correlations among scores and by examining differences among means. The correlations provide assurance that all testers can consistently differentiate relative degrees of fatness among children. Differences between means help to ensure that there are no systematic differences among testers in the amount of fat that they pinch and record.

Interrater reliability at training. As a training exercise, all five testers independently took and recorded skinfolds on 17 children, aged six to nine. In addition, these measurements were taken by the individual who trained the testers and by a second individual, who later served as the "standard" under field conditions. Correlations for the sum of skinfolds consistently exceeded .98. At individual sites, the correlations generally exceeded .97, with no correlations falling below .93. Comparisons of the sum of skinfolds for the five testers against the trainer and against the standard suggest that, during training, there was a tendency for field staff to *underreport* skinfold thicknesses. If anything, a *conservative effect* was operating.

Interrater reliability in the field. Under field conditions, each tester was retested by an individual serving as the standard on 20 children, aged six to nine. Correlations between the standard and each of the testers for sum of skinfolds was .99 for four of the testers and .97 for the fifth tester. Correlations at individual sites generally exceeded .97, and in only one instance did correlations fall as low as .93. The mean sum of three skinfolds for testers was +0.40 higher than for the standard. Taking into account possible variations in other factors, such as minor fluctuations in calibration of the calipers, these findings support the accuracy of the NCYFS II skinfold data.

Tests of differences over time

Two types of analyses were performed to determine whether skinfolds had changed over a period of slightly more than 20 years, from 1963 to 1986.

One-tailed t-tests of significance were performed for each age/sex combination for both the triceps and subscapular sites. Two different points in time were compared separately. This yielded 4 (ages) × 2 (sexes) × 2 (skinfold sites) × 2 (points in time) = 32 total comparisons. In addition to the t-tests, median scores for each age/sex on both sites at two points in time were graphically plotted.

Triceps skinfold. Exhibit 1 shows the differences in mean triceps skinfolds for both boys and girls in NHES II vs. NCYFS II. In comparing the 1960s to the 1980s, the magnitude of difference is 1.7 mm for six- and seven-year-olds and 2.1 mm for eight- and nine-year-olds. All eight differences are significantly different ($p < .005$).

Subscapular skinfold. Exhibit 1 also shows the differences in mean subscapular skinfold for both boys

and girls. As observed for the triceps, the magnitude of difference between the 1960s and the 1980s is highly significant, averaging 1.7 mm for six- and seven-year-olds and 2.3 mm for eight- and nine-year-olds ($p < .005$).

Sum of skinfolds. Exhibit 2 graphically represents differences in the sum of triceps and subscapular skinfold measurements for both boys and girls between two points in time. In comparing the 1960s and 1980s, there is a consistent shift in median sum of skinfolds. The lines describing the increases in body fatness are virtually parallel. It would appear that, over a 20-year period, there has been a general shift in body fatness among six- to nine-year-olds. These findings are consistent with findings of NCYFS I for 10- to 18-year-olds (Pate, Ross, Dotson, & Gilbert, 1985).

Comparisons with results of other research

Gortmaker, et al. (1987), compared mean skinfolds, mean height and weight, and the 95th percentiles for skinfolds and weight for six- to eleven-year-olds based on data collected by NCHS during the 1960s and 1970s. For children aged six to 11 years, mean triceps skinfolds increased 1.7 mm and mean weight increased 1.3 kg over a period of approximately 15 years from the 1960s to the 1970s. Even greater shifts occurred in the 95th percentiles for both skinfolds and weight (4.9 mm and 3.1 kg). These findings suggest that younger children in general are becoming fatter, with this increase accentuated among obese children. Relatively greater shifts in skinfolds than weight were attributed to possible but untested changes in fat distribution.

Summary and conclusions

Over a period of over 20 years, from the 1960s to the 1980s, there has been a systematic increase in skinfold thicknesses among six- to nine-year-old boys and girls alike. The lines describing the changes over time are virtually parallel. NCYFS II data need to be examined further to determine whether the incidence and magnitude of obesity has continued to increase since the 1970s. Further research is also needed to corroborate findings with other measures of body composition (e.g., Body Mass Index). Additionally, changes in activity levels and in nutritional intake of children require careful study to determine changes of lifestyle associated with increasing levels of body fatness.

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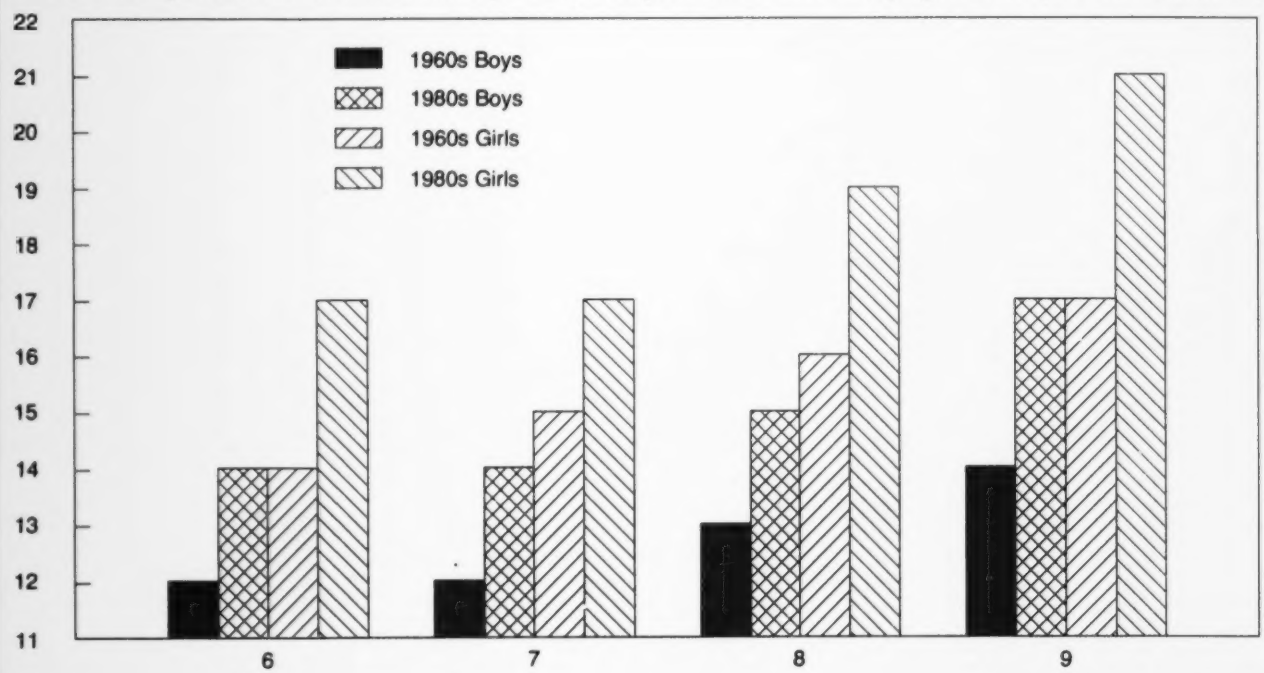
Johnson, F. E., Hamill, D. V., & Lemeshow, S. (1972). *Skinfold thickness of children 6-11 years.* (Series II, No. 120). Washington, DC: U.S. Center for Health Statistics.

Pate, R. R., Ross, J. G., Dotson, C. O., & Gilbert, G. G. (1985). The new norms: A comparison with the 1980 AAHPERD norms. *Journal of Physical Education, Recreation & Dance, 56*(1) 28-30.

Exhibit 2. Comparison of Sum of Median Triceps and Subscapular Skinfold Scores by Age and Sex (NHES II VS NCYFS II)



What Is Going on in the Elementary Physical Education Program?

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What is the status of school physical education programs in grades 1 through 4? This article describes the resources that schools are investing in physical education at the early elementary level and examines the extent to which physical education programs are health related.

From a public health perspective, the school plays a pivotal role in influencing physical fitness and exercise habits of our children. Virtually every child attends school, especially in the elementary years. Physical education, school-sponsored extracurricular physical activity programs, and even monitored recess time could be expected to contribute to the child's fitness and exercise habits.

The 1980 government report, *Promoting Health/Preventing Disease: Objectives for the Nation*, acknowledged the important role schools play in promoting active lifestyles. The report set specific objectives for participation of children in daily physical education programs and in periodic physical fitness testing.

The first National Children and Youth Fitness Study (NCYFS I 1985) described the status of physical education programs in grades 5 through 12. But what about younger children? Are most of them enrolled in a physical education class? What percentage take it daily? How much actual activity time do students get in physical education? How much time do they spend with a physical education specialist versus a classroom teacher? Do schools hold physical education classes in a suitable physical environment? What specific activities are offered most frequently in physical education class? Do schools periodically test the fitness of students? What do they test: health-related fitness or motor performance? Do most students receive some form of recognition for being tested? Are parents informed of fitness test results? How do school-sponsored extracurricular activities and daily recess time fit into the picture?

Survey questions on physical education

The following were among the data collected from teachers of tested children: days per week children take physical education with a specialist; days per week with a classroom teacher; total days of physical education per week; certifications held by those who teach physical education; duration of the physical education class; actual time spent in physical activity; place in which physical education is held; five most frequent activities in physical education; types of fitness tests administered to students; percentage of students recognized for participation in fitness testing; whether fitness test results are reported to parents; opinions of teachers on why elementary school teachers do not do more fitness testing; types of school-sponsored sports teams or other extracurricular physical activity programs; and, finally, number and duration of recess periods on the typical school day. In addition, the enrollment status of each child in physical education was determined.

Physical education enrollment

Nationally, 97.0 percent of students in grades 1-4 are enrolled in a physical education program at school of some type or another (Exhibit 1). Enrollment rates are uniformly high, with virtually no differences among grades or between boys and girls. Such pro-

grams take various forms, ranging from highly structured programs to monitored free-play periods that are allowed to satisfy minimal physical education requirements.

Frequency of class meetings

Educators have stressed the importance of frequent physical education classes, and have strongly recommended daily meetings. One of the 1990 objectives for the nation is that 60 percent of students will participate in daily physical education. A point of concern for elementary schools is the belief that physical education classes are not held with adequate frequency. NCYFS I showed that only 36.3 percent of students in grades 5 through 12 take physical education daily (Ross & Gilbert, 1985). In fact, among first through fourth graders, the situation is virtually identical, with only 36.4 percent enrolled in daily physical education.

The average frequency of physical education for grades 1-4 is 3.1 times per week vs. 3.6 weekly meetings for grades 5-12 (Ross & Gilbert, 1985). Only 15.3 percent of students in grades 1-4 take physical education one day a week and 21.9 percent take it two days a week. A narrow majority of students, or 50.5 percent, take physical education three or more days per week. An additional 4.9 percent take physical education two days one week and three days the next (in an A/B schedule); 4.4 percent take physical education with some other frequency (Exhibit 2).

Bi-modal distribution

There appears to be a bi-modal distribution in the frequency of physical education classes for students in grades 1-4. Those taking physical education only one or two days per week (37.2 percent) are balanced by those taking physical education daily (36.4 percent). Very few students take physical education with frequencies between these extremes.

The bi-modal distribution in grades 1-4 was also found in NCYFS I for grades 5 and 6, but not for older students. Instead, in grades 9-12, the bi-modal distribution is between students taking daily physical education and those *not even enrolled* (Ross & Gilbert, 1985).

While nearly all first through fourth graders are enrolled in physical education, the frequency with which their physical education classes meet is highly variable. It appears that a two-class system has evolved in physical education. The "haves" have physical education five days a week; the "have nots" have physical education only one or two days a week.

Physical activity time

The average physical education class meets for 33.4 minutes, with second graders having the shortest classes (32.0 minutes) and fourth graders the longest (35.4 minutes). In a week, the average student in grades 1-4 spends 102.9 minutes in physical education, with a spread of approximately nine minutes among the grades.

The actual amount of time that students spend in physical activity in the physical education class is

Exhibit 1. Percentage of U.S. Students Enrolled in Physical Education Based on NCYFS II

Grades	Boys	Girls
1	98.2	94.5
2	98.0	97.6
3	97.0	97.0
4	96.7	96.5
1-4	97.5	96.4

Exhibit 2. Percentage Breakdown by Grade: Days of Physical Education Based on NCYFS II

	Grades				
Days/Week	1	2	3	4	1-4
No Physical Education	3.5	2.2	3.0	3.4	3.0
1 day/week	14.9	14.5	17.3	14.7	15.3
2 days/week	22.3	22.6	23.7	18.7	21.9
2 days, one week; 3 days, the next	4.8	3.8	3.7	7.5	4.9
3 days/week	9.6	11.1	5.8	6.4	8.3
4 days/week	2.9	7.8	7.1	5.5	5.8
5 days/week	36.7	35.7	36.8	36.1	36.4
Other	5.4	2.2	2.4	7.7	4.4

Exhibit 3. Average Days Per Week With Physical Education Specialist vs Classroom Teacher, By Grade

Grade	Days with Specialist	Days with Classroom Teacher
1	2.1	0.9
2	2.4	0.9
3	2.3	0.8
4	2.3	0.7
1-4	2.3	0.8

Photograph by Greg Marker

difficult to estimate. Teachers reported spending only about 10 minutes per class on "housekeeping," getting students to and from class, and instruction. The remaining 24 minutes could be spent in some form of physical activity. Though this seems plausible on a group basis, it does not tell us what is happening with individual children during this time. Are they all engaged in fairly continuous exercise, or do they spend much of this time standing and watching? Research by Parcel and others (1987) suggests that the average elementary school student probably spends only two or three *minutes* in moderate to vigorous exercise in the average physical education class.

Teacher credentials

A second point of concern in elementary physical education is the belief that many students do not have the benefit of taking physical education with a qualified specialist. In fact, NCYFS II found that 83.1 percent of students in grades 1-4 take physical education at least one day a week with a specialist. Over three-quarters (76.0%) never see a classroom teacher for physical education. One in 10 take physical education from both a specialist and a classroom teacher.

Approximately 79 percent of physical education class meetings are spent with a specialist. Approximately 2.3 days per week are spent with a specialist versus 0.8 days with a classroom teacher. There is a tendency for students in grades 1 and 2 to spend slightly more physical education time with a classroom teacher than students in grades 3 and 4 (Exhibit 3).

Though children have specialists for physical education, do these specialists hold a proper certification in the field? NCYFS II indicates that many physical education specialists, perhaps as many as *one-third*, do not hold a valid certification in physical education. In addition, because certification requirements vary widely, it is not known what standards the two-thirds who are certified actually meet.

Place for physical education

A third point of concern is that, due to limited resources, many students may take physical education in physical surroundings that are unsuited to the purpose, such as an auditorium or regular classroom. In fact, according to NCYFS II, only 39.3 percent of first through fourth graders typically take physical education in a gymnasium. The school grounds (52.4%) are by far the most common place for physical education. Only 5.9 percent of students take physical education in a cafeteria or multipurpose room, with 2.4 percent taking it in other places, such as an auditorium or a regular classroom. Students typically taking physical education on the school grounds have the benefit of *50 percent more class meetings per week* (3.6) than those not taking physical education on the school grounds (2.4). Use of a gymnasium for physical education remains fairly stable over the four grades.

It is interesting to speculate on why schools hold physical education on the school grounds rather than in a gymnasium. One hypothesis is that schools in temperate climates choose to hold physical education outdoors. In fact, 78 percent of students attending school in temperate climates typically take physical education on the school grounds, but only 31 percent of students in nontemperate climates do so. A second hypothesis is that schools choose not to invest in resources such as specialists and gymnasiums. NCYFS II shows that students who typically take physical education in a gymnasium see a classroom teacher only 0.21 days per week, whereas those who take it outside a gymnasium see a classroom teacher 1.37 days per week. It appears that there is a tendency for some schools to invest in neither a specialist nor a gymnasium.

Predominant class activities

Teachers were asked to list the five physical education class activities which occupy the greatest amount of class time over the school year. Based on their answers, the rates to which children are exposed to a range of activities have been identified. Because only the top five activities were requested, the percent of children exposed to an activity is inevitably somewhat understated. However, the relative ranking of activities should not be affected.

Students in grades 1-4 are ex-

posed to a core set of physical education class activities. The five activities with the highest exposure rates are movement experiences and body mechanics (43%), soccer (32%), jumping or skipping rope (26%), gymnastics (25%), and basketball (21%). In addition, between 15 and 20 percent of students are exposed to throwing and catching activities, calisthenics/exercises, rhythmic activities, kickball, relays, running, and baseball/softball.

Not surprisingly, the relative rates of exposure to specific activities in physical education class vary from one grade to another. Thus, coming up with a list of 10 top activities for each grade requires a list of 18 activities (Exhibit 4).

Certain activities maintain their position in the top 10 throughout grades 1-4. For example, calisthenics/exercises, gymnastics, jumping or skipping rope, relays, and rhythmic activities maintain a fairly constant exposure rate in the top 10 for at least three of the four grades.

Some activities decline while others rise sharply in exposure rates over the four years. The relative importance of low organized games, running/aerobic games, throwing and catching activities, and locomotor activities/basic skills declines as children grow older. In contrast, baseball/softball, basketball, football, kickball, soccer, volleyball, and track and field (not running) take on increasing importance from grade to grade.

The percentage of children exposed to specific physical education activities changes dramatically over the four grades. First, a set of activities called movement experiences/body mechanics holds the number one exposure rate in grades 1 (42%) and 2 (36%). In grade 3, it holds onto the number two position (27%) but, by grade 4, it does not even rank in the top 10. Second, basketball enters the top 10 for the first time in grade 3 with the number five ranking (25%) and, by grade 4, is ranked number 2 (40%). Third, soccer enters the top 10 in grade 2 with the number seven ranking (21%), but leaps to the number one ranking in grades 3 (43%) and 4 (54%). Thus, in grades 3 and 4, a sharp transition occurs, as physical education programs embrace competitive team sports.

It is entirely appropriate that, as children in the early elementary school grades develop greater attention spans, enhance their social skills, and mature physically, their likes and dislikes change along with their aptitudes. Therefore, physical education class offerings should change as well. Concern is justifiable, however, about the sharp transition as early as grade 3 toward competitive team sports. One of the key assumptions in the *Objectives for the Nation* related to physical

Exhibit 4. Rank and Percent Reporting Top 10 Most Frequent Physical Education Class Activities, By Grade

	Grades							
	1		2		3		4	
Physical Activity	Rank	%	Rank	%	Rank	%	Rank	%
Baseball/Softball		*		*	7	.20	6	.20
Basketball		*		*	5	.25	2	.40
Calisthenics/Exercises	5	.22	8	.19	7	.20		*
Football		*		*		*	6	.20
Aerobic and Running Games	6	.21	4	.24		*		*
Low Organized Games	10	.17		*		*		*
Gymnastics	7	.20	3	.25	4	.26	3	.28
Jumping or Skipping Rope	4	.24	2	.28	2	.27	5	.23
Kickball		*		*	6	.21	4	.26
Locomotor Activities/Basic Skills	3	.26	6	.22		*		—
Movement Experiences/Body Mechanics	1	.42	1	.36	2	.27		*
Relays	10	.17	8	.19		*	8	.17
Racing/Sprinting	9	.18		*		*		*
Rythmic Activities	7	.20	8	.19	9	.18		*
Soccer		*	7	.21	1	.43	1	.54
Throwing and Catching	2	.29	4	.24	10	.15		*
Track and Field (not running)		*		*		*	10	.14
Volleyball		*		*		*	9	.16

Activities marked with an asterisk(*) were performed, but did not enter the top 10 for a grade. Activities marked with a dash(—) were not performed by a grade.

education is that, "school based programs will embrace activities which expand beyond competitive sports." NCYFS I found that present school physical education programs in grades 5-12 are not geared to this goal (Ross & Gilbert, 1985). With the sharp transition toward competitive team sports, early elementary programs may also be moving in the wrong direction.

Fitness testing

Fitness testing serves several purposes including educating students about the various components of physical fitness, tracking changes in fitness levels over time, providing students, parents, and teachers with information concerning the fitness of children (including areas of need for fitness improvement), providing a basis for the development of personal exercise programs, and motivating students to improve their fitness levels and exercise habits. One of the 1990 objectives for the nation is that 70 percent of students will participate in periodic fitness testing.

An important finding of NCYFS II is that elementary schools have not adopted physical fitness testing programs on a broad basis and, when they have, their programs have not been health related. This finding comes as no particular surprise because norms for children under age 10 have been available only since 1980 (AAHPERD, 1980). However, the survey found that 49.7 percent of students in grades 1-4 attend schools that conduct some type of periodic fitness testing at their grade level. A much higher proportion of students in grades 3 (56.2%) and 4 (69.2%) are exposed to fitness testing programs than in grades 1 and 2 (37.7%).

As expected, the six most frequently used test items, all with exposure rates of 60 percent or higher, are the standing long jump, flexed-arm hang, pull-ups, sit-ups, dash, and shuttle run. All six items come from the old AAHPERD Youth Fitness Test (YFT), which is primarily a test of motor performance (Hunsicker & Reiff, 1976). Between 30 percent and 60 percent of students are exposed to a variety of other fitness tests, such as push-ups, chin-ups, softball throw, and 600-yard run. Test items more recently introduced in the AAHPERD Health Related Physical Fitness Test (HRPFT) and with lower exposure rates include a sit-and-reach test (26.7%), mile walk/run (17.6%), and skinfolds (8.7%). The most frequently used test item is the sit-up test, which is the one item included in both the YFT and HRPFT.

Why is there not more fitness testing in elementary schools? This question was posed to the teachers of students participating in NCYFS II. The most frequent explanations, in declining rank order, were as follows: "There isn't enough class time" (82%); "the classes are too big" (51.5%); "teachers don't know how to administer certain tests" (41.4%); "the mandated curriculum doesn't include testing" (38.1%), "the main interest is movement education, not fitness or sports skills" (34.5%), "teachers don't like the available tests" (24.4%), and "teachers don't like to encourage competition among the children" (21.8%). Few teachers said that testing posed an unacceptable risk of injury, children did not like being tested, the school did not allow it, testing was irrelevant in a nongraded program, or parents were opposed to testing.

Even more interesting are the differences in response patterns between teachers who test and those who do not. Teachers who do not test offered four reasons with significantly greater frequency than those who do ($p < .005$ in a two-tailed t-test). Nontesting teachers claim that there is not enough class time for testing, the classes are too big, many teachers do not know how to administer certain tests, and many teachers do not like the available tests. Two additional reasons were offered by nontesting teachers with significantly greater frequency ($p < .02$): risk of injury is too great and testing is irrelevant in a nongraded course.

Based on NCYFS II, one can see that the majority of children in grades 1-4 are not involved in a comprehensive, well-planned fitness testing program. Few programs test children for those aspects of physical fitness that are of widest concern to adults. In large part, this may be because teachers do not like the traditional tests of motor performance but are not familiar with or do not know how to administer newer fitness tests.

Reporting fitness test results

It is generally acknowledged that many children and youth are less fit than they might be. In the attempt to improve fitness levels, it has been suggested that students be rewarded for their fitness accomplishments. Such rewards, it is argued, will motivate them to try to improve their performance on fitness tests. NCYFS II indicates that reward systems vary widely and do not appear to be well thought out. Slightly less than one-half of students (49.5% in grades 1-4) who attend schools that conduct fitness testing programs receive recognition for test performance. Because less than one-half of all children have the opportunity to take fitness tests, somewhat less than one-quarter of children are rewarded. Less than one-quarter (23.2%) of students attend schools that test but recognize no one; 39.8 percent attend schools that test and recognize everyone. The proportion of students who are recognized seems to decline from grade to grade. However, this is primarily because schools typically recognize 100 percent of first and second graders. Excluding schools that recognize everyone, the recognition rate is fairly constant from grade-to-grade.

The principal method of reporting fitness test results to parents is the child's report card. The parents of three of five students attending schools that test fitness (about 29% of all children) receive some type of report of their child's fitness

(grades 1-4).

Parents are interested in the health and fitness of their children, yet too few parents receive feedback of test results. If fitness is going to be improved among American youth, it can be argued that parents must aid in the process by encouraging out-of-school exercise. Fitness test results, if available, could provide parents with information which may stimulate them to encourage activity for their children. Further, it has been argued that rewards for fitness performances can motivate children to become involved in out-of-school activities. If this is true, a more systematic and well-thought-out system of rewarding children should be considered for our youth.

Recess time

Recess time provides a break to both students and teachers. Perhaps inappropriately, it is often viewed as a supplement to physical education. Therefore, it is important to know how much recess time children are receiving.

The average student in grades 1-4 receives 1.48 recesses in a day with the average recess lasting 18.32 minutes. The average daily recess time totals 30.1 minutes and is fairly constant across the four grades. The importance of recess time becomes clear when it is recalled that the average student takes only 3.1 physical education classes per week for approximately 35 minutes. Nearly as much time is spent in recess daily.

Based on NCYFS II, there is a strong *negative* relationship ($R = -.21$; $p < .001$) between daily recess time and weekly physical education time. This suggests that schools use recess to compensate for inadequate physical education programs. It also suggests that schools are typically willing to give just so much time to physical activity. Children who take a daily physical education class are thought not to need or be entitled to as much recess time. However, children need both structured time in physical education and discretionary time at recess. Recess can be presumed to contribute in important ways to the child's physical and mental well-being. Recess should not substitute for physical education nor should physical education substitute for recess.

Sports teams and extracurricular activities

Sports teams and extracurricular physical activities give students the opportunity for additional exercise, including the prospect of competition. If such programs encourage participation by students of widely varying skill levels, they can make an important contribution to the fitness of children.

Only 18.9 percent of students in grades 1-4 have the opportunity to participate in sports teams or extracurricular physical activities. The lowest opportunity is at grade 2 (10.2%) and the greatest opportunity comes in grade 4 (34.2%). The average number of different options in schools offering team sports and extracurricular physical activities is 1.72, ranging from a low of 1.2 in grade 2 to 2.17 in grade 4.

The most frequently offered sports and extracurricular physical activities, in declining rank order, are basketball, jumping or skipping rope, soccer, and games (unspecified). Tied for the fifth rank are baseball/softball, folk/square/ballroom dance, gymnastics, and track and field (not running).

Like the activities in physical education, extracurricular offerings also change from one grade to another (Exhibit 5). In grades 1 and 2, the top activities, in declining rank order, are jumping or skipping rope, rollerskating, games (unspecified), and soccer. Basketball enters the picture in grade 2 in a tie with soccer. Priorities begin to shift in grade 3, when basketball jumps from the number four rank (1%) to the number one position (7%), which it retains in grade 4 (19%). Jumping or skipping rope

Exhibit 5. Rank and Percent Reporting Top 5 Most Frequent Sports Teams and Extracurricular Physical Activities, By Grade

Physical Activity	Grades 1		2		3		4	
	Rank	%	Rank	%	Rank	%	Rank	%
Baseball/Softball		—		—		—	3	.05
Basketball		—	4	.01	1	.07	1	.19
Folk/Square/Ballroom Dance		—		—	4	.03		*
Games Unspecified	2	.02	2	.02	5	.02		*
Gymnastics		—		—		—	3	.05
Jumping or Skipping Rope	1	.06	1	.06	2	.04	3	.05
Rollerskating	2	.02	2	.02	5	.02		—
Soccer	4	.01	4	.01	2	.04	2	.11
Track and Field (not running)		—		—	5	.02		—

Activities marked with an asterisk (*) were performed, but did not enter the top 5 for a grade. Activities marked with a dash (—) were not performed by a grade.

maintains the same approximate exposure rate during all four years, but declines in rank, as competitive sports are gradually introduced. Soccer, like basketball, rises from the number four rank in grades 1 and 2 to the number two slot in both grades 3 (4%) and 4 (11%). Gymnastics also enters the picture in grade 4, vying with jumping or skipping rope for the third rank (5%).

Summary and conclusions

Major questions to be answered in NCYFS II included: (1) HOW MUCH physical education do our children receive?; (2) WHO teaches physical education?; (3) WHERE are physical education classes conducted?; and (4) WHAT actually goes on in physical education classes?

How much physical education do our children receive? While it was expected that most students would receive physical education of some type in grades 1-4, it came as a pleasant surprise that the 97 percent enrolled in physical education attend class an average of 3.1 times weekly, with 36.4 percent attending classes daily. However, it appears that a two-class system has evolved at the early elementary school level. The "haves" take physical education daily; the "have nots" (37.2%) take physical education only one or two days per week.

It is also interesting that how much physical education a child receives is inversely related to the amount of recess received. Children need discretionary time just as they have a need for physical education instructional time. Recess periods may be used to supplement, but not substitute for, structured physical education. Nor should physical education time be allowed to replace recess time.

Evidence from this survey suggests that regular exercise can be increased among many children through an increase in extracurricular activities. More opportunities for those in the lower grade levels may be necessary.

Who teaches physical education? The fact that a high proportion of physical education classes are taught by specialists (79%) was also a surprise. However, this finding alone distorts the picture because many specialists, perhaps as many as one-third, do not hold valid certification in physical education. Further, there is some question as to the extensiveness of the qualifications of those who hold certification in physical education. There is cause for concern that some schools do not make the investment needed to hire a certified physical education specialist.

Where is physical education taught? In a majority of cases, it is *not* in a gymnasium. In more temperate climates, the outdoors may be the most suitable location for many activities. Still, there is concern that more than a few schools not providing specialized physical education teachers appear to be also unwilling or unable to support adequate teaching facilities.

What do children do in physical education? Results indicate that, from grade 1 to grade 4, a marked transition occurs in the activities conducted in physical education classes. The emphasis changes from movement education to fitness activities and sports skills. The dramatic shift toward team sports as early as grades 3 and 4 gives cause for concern. One of the key assumptions in *Objectives for the Nation* related to school physical education is that, "school-based programs will embrace activities which expand beyond competitive sports." Both the results of NCYFS I, and this study (NCYFS II), indicate that this important national goal is *not* being met.

There is little doubt that if the goals for the nation are to be met, action must be taken to improve the amount of time spent in physical education, to ensure that students are receiving instruction from qualified teachers, and to improve the facilities for these important educational programs. All of these are factors largely beyond the direct control of physical educators.

However, NCYFS II data do highlight several factors about which professional physical educators *can* do something. First, they can commit themselves to the *Objectives for the Nation,* which focus on health and fitness for all youth. Second, they can select activities which are appropriate for the age level of children and consistent with the stated health goals for the nation. Third, they can make efforts to design class experiences which make the most of the limited time now available for physical education. Finally, professional physical educators can adopt fitness testing programs which are consistent with developmental needs of students, promote lifetime exercise, motivate children to perform regular exercise, and keep parents aware of the fitness and exercise needs of their children. These efforts will make the most of the physical education experience and could promote active lifestyles beyond the boundaries of the school.

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Home and Community in Children's Exercise Habits

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There is a strong correlation between exercise habits of parents and those of their children.

While the contribution of the school to a child's exercise habits is important, the role of family and community in providing models and opportunities for exercise should not be overlooked. Among children under age 10, home and community exert powerful influences in all phases of life, including exercise habits. The 1980 government report, *Promoting Health/ Preventing Disease: Objectives for the Nation,* recognized the importance of a variety of sources of physical activity other than schools by setting as an objective that, "By 1990, data should be available for regular monitoring of national trends and patterns of participation in physical activity, including participation in public recreation programs in community facilities. (U.S. Department of Health and Human Services, 1980).

The National Children and Youth Fitness Study II (NCYFS II) sought to answer a number of questions about the physical activity patterns of early elementary school children in the context of home and community, such as: Do parents rate the overall activity levels of their children as somewhat sedentary, as media pundits suggest? How do teachers rate the relative activity levels of boys and girls? How much television do children actually watch, both on school days and on weekends? Are the children who watch a lot of television, in fact, the more sedentary ones? What percentage of children make use of community organizations—such as sports teams, YMCA's, and parks and recreation programs—as sources of exercise? In what types of physical activities do children engage through such organizations?

NCYFS II also posed several questions about the parents of early elementary school children, such as: How often do the parents engage in moderate to vigorous exercise? How do parents view their own overall activity levels? How frequently do parents spend just 20 minutes exercising with their children? What relationship is there between exercise habits of the parents and those of the children?

Survey questions about physical activity patterns

A physical activities survey administered to the parents of children participating in NCYFS II gathered the following data: the parent's rating of the child's physical activity level versus same-sex peers; number of hours of television watched by the child (on school days, on weekends); community organizations through which the child engaged in physical activity at least three times in the past year (check off); the child's five most frequent physical activities in these organizations; number of days per week each parent obtains exercise that causes rapid breathing and a fast heart beat for 30 continuous minutes or more; each parent's rating of his or her own physical activity level; and the number of days per week that each parent exercises with the child for 20 minutes or more. In addition, teachers rated the physical activity level of each child relative to class members.

Activity levels of children

It is a common perception that children are becoming more sedentary, due to a variety of basic lifestyle changes. Do parents think that their children are underactive? Do teachers think that their students tend to be sedentary?

To answer these questions, both parents and teachers were asked to rate the child's overall physical activity level on a 5-point scale, with "3" representing the "average" child of the same age and sex, "5" a child who is a lot *less* physically active than most, and "1" a child who is a lot *more* physically active than most. Ratings of "4" and "2" represented children who were per-

Exhibit 1. Parent and Teacher Ratings of Activity Levels of Children Relative to Same-Sex Peers, Grades 1-4

	Parent Rating	Teacher Rating
A lot more physically active than most	12.8%	16.8%
A little more physically active than most	26.9%	19.1%
Average, same as most	50.3%	42.1%
A little less physically active than most	8.7%	13.7%
A lot less physically active than most	1.4%	8.3%

ceived as a little less and more active than most respectively.

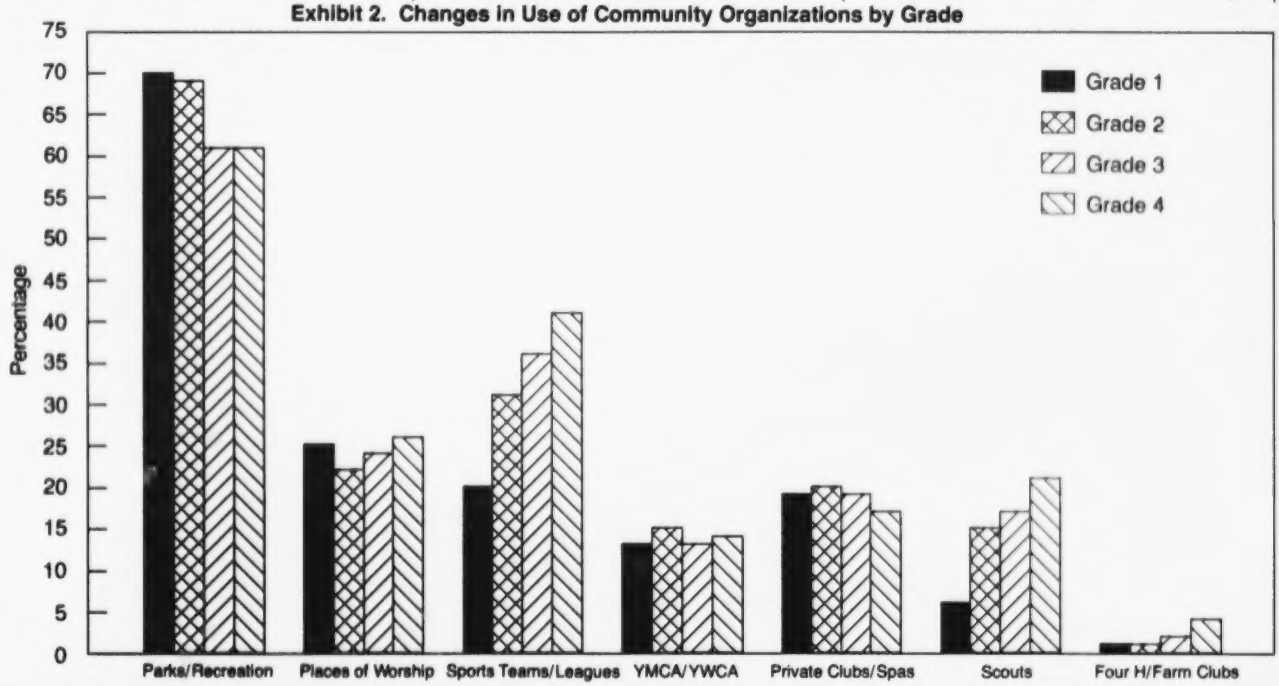
Prior research provided no clear set of expectations for how parents and teachers would rate the activity levels of children. Other studies have shown that the overwhelming majority of adults rate themselves as average or above average (U.S. Department of Health and Human Services, 1985); parents and teachers might be expected to do the same in rating the children. It also seemed reasonable that parents and teachers of young children might think of them as overactive, in the sense of being difficult to control. At the same time, with all the media attention on the sedentary ways of America's youth, it seemed plausible that adults might acquiesce by rating the children as sedentary.

The ratings of the children look very similar to the self-ratings of adults found in prior studies (U.S. Department of Health and Human Services, 1985). Parents rate 50.3 percent of their children as average, 39.7 percent as above average, and only 10.1 percent as below average. Teachers rate 42.1 percent of their students as average, 35.9 percent as above average, and 22.0 percent as below average (Exhibit 1). The average activity level ratings were 2.59 by parents vs. 2.78 by teachers.

Parents and teachers seem to disagree in how they see the differences between boys and girls. Parents view boys as slightly more physically active than girls, giving an average score of 2.53 to boys vs. 2.66 for girls. The teachers gave the boys an average rating of 2.56, which is virtually identical to the rating of 2.53 given by the parents. However, the average teacher rating of the girls was 3.01, almost a perfect "average" score. This score is dramatically different from the teacher rating of 2.53 for boys and from the parent rating of 2.66 for girls ($p < .001$ in a two-tailed t-test). One possible explanation is that parents compared their children to peers of the same age/sex, but teachers pooled boys and girls in rating their students. There are no consistent patterns in changes from grade to grade in activity level ratings.

Do parents and teachers define "physically active" in the same way? Are they measuring the same behavior? The correlation between parent and teacher activity level ratings is rather strong ($R = +0.23$; $p < .001$). However, it seems that parents and teachers may use somewhat different criteria to assess activity level. It also seems likely that children display different behaviors for parents versus teachers in the home and school settings. Several low order, but statistically significant correlations between the activity level ratings

Exhibit 2. Changes in Use of Community Organizations by Grade



and other variables suggest some of the sources of difference. Both parent and teacher ratings reflect such factors as the child's participation in physical activity through community organizations, especially participation in organized sports. The parent activity rating also seems to account for the child's television watching time, number of days per week that mother and father exercise, and days per week that parents exercise with the child. The teacher's activity rating is not differentiated by any individual level variables, but seems related to several aspects of the school's overall physical activity program. Therefore, it seems that parents and teachers are, in fact, taking different factors into account, but that they may also see different behaviors.

Television watching

Spending a lot of time in television watching has come to be associated with a sedentary lifestyle. Widely-cited reports allege that the amount of time children spend in front of a television has increased over the past decade. The National Assessment of Educational Progress (NAEP), which has tracked television watching among children in grades 4, 8, and 11 for 15 years, indicates that 32 percent of fourth graders report watching six or more hours of television daily. NAEP also indicates that television watching is highest at grade 4, and progressively lower in grades 8 and 11 (Anderson, Mead & Sullivan, 1986).

Recognizing that NAEP addressed its questions directly to students, information was sought on the child's television watching directly from parents. Attempts were also made to differentiate between hours spent in television watching on school days versus weekend days. In all other ways, the question about television watching was identical to the NAEP question.

The results call into question how much anyone really knows about children's television watching behavior. For fourth graders, NAEP indicates that 32 percent watch zero to two hours of television daily, 38 percent watch three to five hours, and 30 percent watch six or more hours (Anderson, Mead & Sullivan, 1986). In NCYFS II, 69.3 percent of fourth graders watch zero to two hours on school days, 27.1 percent watch three to five hours, and 3.6 percent watch six or more hours. On weekends, 25.3 percent of NCYFS II fourth graders watch zero to two hours, 63.3 percent watch three to five hours, and 11.3 percent watch six or more hours. The differences between NAEP and NCYFS II are difficult to reconcile.

For children in grades 1-4, NCYFS II indicates that, on school days, 72.3 percent watch zero to

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two hours of television, 27.0 percent watch three to five hours, and only 0.7 percent watch six hours or more. On weekends, 28.3 percent of first through fourth graders watch zero to two hours of television daily, 61.0 percent watch three to five hours, and 10.8 percent watch six or more hours. They watch an average of two hours and two minutes (2:02) on school days versus 3:26 on weekends. On the average, boys watch slightly more television than girls, both on school days (2:04 vs. 2:00) and on weekend days (3:28 vs. 3:24). On school days, television watching time increases by grade, for boys from 2:01 to 2:07 and for girls from 1:53 to 2:08. On weekend days, television watching time increases for boys from 3:15 to 3:33 and for girls from 3:13 to 3:33. Thus, any differences in television watching behavior between boys and girls seem to be erased by grade 4.

Whom do you believe? NCYFS II findings more closely resemble those from a Michigan study of time use in which the child (with a parent's help, if under age nine) kept a detailed diary of daily activities (Timmer, Eccles & O'Brien, 1983). In the nine to 11 year old Michigan group, which is comparable to our fourth graders, school day television watching time (2:26) was slightly higher than in NCYFS II (2:08). However, the weekend television watching time in Michigan (3:05) was somewhat lower than in NCYFS II (3:33). This suggests that estimates of television watching are highly dependent upon the context in which the question is asked. It seems possible that current media reports on television watching may be exaggerated.

What does it all mean? The amount of time a child spends in watching television seems to be related to how active the child is. The less television a child watches, the higher the parent's rating of the child's physical activity level, as mentioned above. In addition, the less television a child watches, the more likely the child is to be involved in organized sports and a variety of other activities through community organizations (such as sports leagues, YMCA's, private clubs, and scouts). Thus, television watching is an important indicator of how physically active our children are.

Community organizations

Community organizations provide the opportunity for participation in organized sports as well as a wide range of other physical activity programs. Only 15.7 percent of first through fourth graders did not participate in the physical activity program of at least one community organization. In the course of a year, 36.0 percent participate in physical activity through one community organization, 27.6 percent through two, and 20.6 percent through three or more. The average student engages in physical activity through 1.61 community organizations, with boys (1.65) having a slight edge over girls (1.56). The average number of community organizations providing physical activity increases from first (1.43) through fourth (1.78) grade. In first grade, girls participate in physical activity through slightly more community organizations (1.46) than boys (1.41); however, by grade 4, boys participate in substantially more community organizations (1.93) than girls (1.62).

Parks and recreation. Public parks and recreation department programs attract two out of three first through fourth graders (65.3%). Such programs are most often used by first and second graders (69.4%) and less frequently used by third and fourth graders (60.8%) (Exhibit 1). Utilization rates are virtually identical for boys and girls.

Sports leagues and teams. Community-based sports leagues and teams provide exercise opportunities for 31.9 percent of children in grades 1-4. At least twice as many boys (42.4%) as girls (20.4%) partic-

Exhibit 3. Rank and Percent Reporting Physical Activities Most Frequently Performed in Community Organizations, Top 10 by Grade for Boys

Activity \ Grade	1		2		3		4	
	Rank	%	Rank	%	Rank	%	Rank	%
Baseball	7	.11	4	.20	3	.29	3	.32
Basketball		*	8	.08	7	.11	5	.17
Bicycling	5	.15	5	.13	5	.17	5	.17
Calisthenics/Exercises		*	8	.08		*	9	.08
Climbing Ropes/Trees/Monkey Bars	6	.13	7	.09		*		*
Football		*		*	6	.13	7	.15
Hiking/Backpacking		*		*	8	.08	8	.09
Locomotor Activities	8	.10	8	.08		*		*
Playing (unspecified)		*		*	8	.08		*
Playing on Playground	3	.17	6	.12	10	.07		*
Racing/Sprinting	1	.34	2	.31	2	.33	2	.33
Soccer	4	.16	3	.24	4	.21	4	.26
Swimming	2	.32	1	.39	1	.34	1	.38
T-Ball	9	.09	8	.08		*		*
Walking	10	.07		*		*	9	.08

Activities marked with an asterisk (*) were performed, but did not enter the top 10 for boys at a particular grade level.

Exhibit 4. Rank and Percent Reporting Physical Activities Most Frequently Performed in Community Organizations, Top 10 by Grade For Girls

Activity	Grade 1 Rank	1 %	2 Rank	2 %	3 Rank	3 %	4 Rank	4 %
Baseball		*		*	7	.09	4	.14
Bicycling	4	.13	3	.16	3	.14	3	.17
Calisthenics/Exercises		*		*	7	.09		*
Climbing Ropes/Trees/Monkey Bars	5	.12	5	.10		*		*
Ballet/Jazz/Modern Dance	10	.07		*		*		*
Other Dance		*	8	.09		*		*
Gymnastics	6	.11	10	.08	7	.09	7	.10
Hiking/Backpacking		*	10	.08	6	.10	5	.11
Jumping or Skipping Rope		*	8	.09		*		*
Locomotor Activities	6	.11		*		*		*
Playing (unspecified)	8	.09		*		*	9	. 08
Playing on Playground	3	.18	4	.15	4	.13	8	.09
Roller Skating		*	5	.10		*	9	.08
Racing/Sprinting	2	.34	2	.35	2	.30	2	.28
Soccer		*		*		*	9	.08
Swimming	1	.35	1	.39	1	.39	1	.43
Walking	9	.08	5	.10	5	.11	5	.11

Activities marked with an asterisk (*) were performed, but did not enter the top 10 for girls at a particular grade level.

ipate in such programs. Participation in sports teams and leagues increases twofold from first grade (19.7%) through fourth grade (41.4%). The difference in participation rates between boys and girls is lowest in absolute terms but greatest in relative terms in grade 1 (27.8 vs. 10.2%). After grade 1, as overall participation rates increase, the difference in participation rates between boys and girls remains approximately 24 percentage points. By grade 4, 53.1 percent of boys but only 29.4 percent of girls participate in a sports team or league.

Churches. Churches and other places of worship provide an opportunity for physical activity for 24.2 percent of children in grades 1-4, with very little difference between boys (23.0%) and girls (25.5%). Use of churches for physical activity remains virtually constant from grade 1 (24.7%) through grade 4 (25.8%). Only in grade 1 is there a significant difference between boys (21.6%) and girls (28.4%).

YMCA's and YWCA's. Y's of various types provide exercise opportunities for 13.9 percent of children in first through fourth grade. Boys (14.5%) are slightly more likely than girls (13.4%) to participate in an exercise program at a Y. Utilization rates remain constant from first (13.5%) through fourth (14.3%) grades. By grades 3 and 4, boys have a slight edge over girls in utilization rate of approximately 2 percentage points.

Clubs and spas. Various health clubs and private spas provide a setting for physical activity for 18.9 percent of children. Girls (22.9%) are much more likely to patronize such organizations than are boys (15.3%). There is no consistent variation in use from grade to grade. However, the spread between boys and girls gradually decreases from 10 percentage points in grades 1 and 2 to less than two percentage points in grade 4.

Scouts. Brownies, Cub Scouts, and other scouting groups attract 14.6 percent of youngsters in this age group. Girls have a decided edge over boys, with only 11.7 percent of boys participating in physical activity through scouting groups compared to 17.7 percent of girls. Utilization increases gradually from 5.6 percent in grade 1 to 21.4 percent in grade 4. The relative spread between boys and girls is wide in grade 1 (2.2 vs. 9.6%), grade 2 (8.9 vs. 21.1%), and grade 3 (12.2 vs. 22.7%). By grade 4, the boys (25.0%) overtake the girls (17.8%).

Farm clubs. Four-H and other farm clubs provide opportunities for exercise for 2.1 percent of first through fourth graders, with more girls (2.7%) than boys (1.6%) using them. Utilization rates increase from 1 percent or less in grades 1 and 2 to 4.3 percent in grade 4. More girls participate in Four-H and other farm clubs at each grade, with only 2.9 percent of boys compared to 5.8 percent of girls participating by grade 4.

Exhibit 5. Self-Rated Activity Levels of Adults with Children in Grades 1-4

	Mother or Female Adult	Father or Male Adult
A lot more physically active than most	8.2%	16.7%
A little more physically active than most	21.8%	27.3%
Average, same as most	43.8%	36.0%
A little less physically active than most	17.2%	13.1%
A lot less physically active than most	9.0%	6.8%

Predominant physical activities in community organizations

Under the auspices of community organizations, children have a range of options for physical activity. Some of these mirror those available in a school setting, but many are unlikely to occur in a school. Some activities are done with equal frequency by both boys and girls, while others are done more frequently by one or the other. Some activities continue to be performed as children grow older, while others decline or rise in predominance.

Parents were asked to list the types of exercise or physical activity in which the child participated over the past year from any of the community organizations listed above. Parents could list up to five activities. From answers to this question, the five activities most frequently performed in community organizations by first through fourth graders, in declining rank, are: swimming, racing/sprinting, baseball/softball, bicycling, and soccer. The next 11 most popular activities, again in descending order, are: playing on a playground, climbing ropes/monkey bars/trees, locomotor activities and skills (such as jumping and hopping), walking, hiking/backpacking, gymnastics, playing (unspecified), basketball, calisthenics/exercises, football, and rollerskating.

Several activities maintain their position among the top 10 over the four-year span. Swimming, racing/sprinting, and bike riding stay in the top five for both boys and girls at each of these grades (Exhibits 3 and 4). Soccer retains its fourth rank among boys. Walking and gymnastics retain the fifth and seventh ranks respectively among girls.

A number of activities move up in importance as children grow older. For boys, baseball/softball moves from the seventh to the third rank between grades 1 and 4; for girls, it breaks into the top 10 in third grade and holds the fourth rank in grade 4. Basketball enters the top 10 for boys in grade 2 and holds the fifth rank by grade 4; for girls, it never breaks into the top 10. Football achieves the top 10 for boys in grade 3, holding the seventh rank in grade 4; football never enters the top 10 for girls. Hiking/backpacking makes the top 10 for boys and girls in third and fourth grades respectively; by grade 4, it ranks eighth among boys and fifth among girls. Soccer participation by girls increases gradually, but does not break the top 10 until grade 4.

Other activities naturally decline in importance. Climbing ropes/trees/monkey bars is in the top 10 for first and second grade boys and girls, but then drops out. Similarly, locomotor activities/basic skills drops out of the picture by third grade. Playground play gradually declines in importance, but stays in the top 10 list until third grade for boys and for all four years for girls. T-ball drops off the list for boys after grade 2 but never makes the top 10 for girls.

In addition, a number of activities appear in the top 10 list only sporadically. Calisthenics/exercises and playing (unspecified) occasionally break into the top ten for both boys and girls. Ballet/jazz/modern dance, other dance, jumping or skipping rope, and rollerskating can intermittently be found in the top 10 for girls. Walking appears in the top 10 for boys at two grade levels.

Physical activity among parents

Exercise habits of parents can be expected to affect children through a modeling effect or other means. Therefore, attempting to understand the exercise habits of parents is germane to a discussion of physical activity in first through fourth graders.

Estimating physical activity levels and the frequency of appropriate physical activity among adults is important from a public health perspective. The *Objectives for the Nation* set specific goals for exercise participation by adults. As noted above, adults tend to view themselves as somewhat more active than average. Efforts to determine the percentage of adults participating in continuous, moderate to vigorous physical activity (MVPA) have produced varied results, largely as a function of method. The best available estimates indicate that only 7.8 percent of adults participate in MVPA for 20 continuous minutes or more at least 3 days per week, which is an often-cited criterion for appropriate physical activity (Caspersen, Christenson & Pollard, 1986).

Parents were asked to rate their own activity levels relative to peers of the same age/sex. They were also asked to report the number of days in a typical week on which they "get exercise that causes rapid breathing and a fast heart beat for 30 continuous minutes or more."

The results for self-rated activity level closely resemble the teacher ratings of students. The average mother scored an almost perfect "average" score of 2.97 on a five-point scale; in contrast, the average father scored a 2.66. For mothers, 30.0 percent were above average, 43.8 percent were average, and 26.2 percent rated below average. Among fathers, 44.0 percent were above average, 36.0 percent rated average, and 13.1 percent were below average (Exhibit 4). These results are consistent with prior research on adults (U.S. Department of Health and Human Services, 1980).

Self-reported participation in MVPA cannot readily be compared to other research, because our population is limited to parents of first through fourth graders. Therefore, it is a relatively young group, presumably more active than adults in general. NCYFS II indicates that 42.1 percent of mothers and 48.0 percent of fathers of children in grades 1-4 do not participate in MVPA in the typical week. Among mothers, 13.2 percent exercise one day per week, 16.1 percent exercise two days per week, and 28.6 percent meet the criterion for appropriate physical activity by exercising three or more

days per week. Among fathers, 10.7 percent exercise one day per week, 11.4 percent exercise two days per week, and 29.9 percent exercise three or more days per week. The average mother exercises 1.59 days per week versus 1.65 days per week for the average father.

The frequency of parental exercise may be related to the age and sex of the child. The exercise frequency of mothers is higher if she has a girl rather than a boy in first grade ($p < .001$ in a two-tailed t-test); however, by third grade, these differences have evened out. In general, the frequency with which mothers exercise appears to be unrelated to the sex of the child. Not surprisingly, fathers generally appear to exercise more frequently if there is a young boy in the family. This difference (1.60 vs. 1.69 days weekly) approaches statistical significance ($p < .06$). The difference is greatest in fourth grade, when fathers who have a boy exercise 1.67 days per week while fathers with girls exercise only 1.4 days per week. A limitation of NCYFS II is that data were not collected on siblings; therefore, their impact on the exercise patterns of the children and parents cannot be examined.

Parental exercise with children

The frequency with which mothers and fathers exercise with their children can be presumed to communicate to the child something about the parental value associated with exercise. As a result, it could contribute to the child's immediate physical activity level and long-term adherence to exercise programs.

Parents were asked on how many days in a typical week they exercise with the child for 20 minutes or more. It was disappointing but not surprising that 58.1 percent of mothers and 61.7 percent of fathers said they do not exercise at all with their child in the typical week. Among mothers, 17.6 percent exercise with their child one day per week, 13.6 percent two days per week, 5.6 percent three days per week, 2.0 percent four days per week, and 3.1 percent five or more days per week. Among fathers, 14.9 percent exercise with their child one day per week, 12.0 percent exercise two days per week,

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6.0 percent exercise three days per week, 2.7 percent exercise four days per week, and 2.6 percent exercise with their child five or more days per week.

The frequency of exercise with children depends on the sex of the child for fathers, but not for mothers. Mothers exercise with their child .87 days per week. They spend slightly more time with daughters (.91 days) than with sons (.84 days); however, this difference is not statistically significant. Fathers, however, exercise with their child .82 days per week. They spend much more time, .96 days per week, exercising with sons, compared to .68 days spent with daughters. On an annual basis, this translates into 50 days spent exercising with sons versus only 35 days with daughters. This discrimination in treatment of sons versus daughters is most accentuated in grade 4, when fathers exercise .96 days per week with sons but only .53 days per week with daughters. This difference ($p < .001$), is in evidence at grades 1, 2, and 4.

The frequency with which parents exercise with their children is directly related to the frequency with which the parents themselves exercise. There is a strong correlation between the total days that either parent exercises with the child and mother's exercise days ($R = +0.30$) and father's exercise days ($R = +0.29$).

It is clear that parents do not spend much time exercising with their children. The ones who do are, in large part, the ones who are already setting positive role models by their own exercise behavior. Mothers exercise with sons and daughters with equal frequency; however, fathers clearly discriminate in favor of sons. This difference is most pronounced in grade 4, by which time boys have begun to participate in competitive team sports in large numbers. Anticipating the likelihood that first through fourth grade boys will increase their participation in competitive sports much more than girls, it can be expected that fathers will continue to exercise progressively more with sons and less with daughters. There is much opportunity here for change.

Summary and conclusions

Exercise and physical activity at home and in the community can contribute in significant ways to the fitness of young children. NCYFS II found that nearly all children participate in physical activity through at least one type of community organization, making this an important vehicle for affecting fitness and physical activity habits. Most community organizations are equally used by both boys and girls, at least by grade 4. The exception is sports teams and leagues, which attract twice as many boys as girls.

Recognizing the potential role of parents in influencing the fitness and exercise habits of children, it is significant that fewer than 30 percent of mothers and fathers of first through fourth graders participate in appropriate physical activity. Even more alarming is that approximately 50 percent of parents of relatively young children say that they *never* obtain vigorous exercise.

Mothers and fathers exercise with their children less than once a week, on the average. Though mothers exercise with equal frequency with sons and daughters, fathers clearly spent much more time exercising with sons. This imbalance is most pronounced in grade 4, when boys in large numbers turn to competitive team sports. This suggests the start of a pattern that may be perpetuated throughout the school years.

Statistics from prior studies, widely circulated in the media, may exaggerate the amount of television that children watch. Nevertheless, television watching does directly take away from time that could be spent in other more constructive activities, including exercise. Children who watch greater amounts of television tend to be rated as having lower activity levels and are less likely to participate in organized sports or to receive physical activity through community organizations.

Among both children and adults, the average male is rated as somewhat above average in physical activity level, while the average female is rated "average" for persons of the same age and sex. This mathematical incongruity suggests that there is a strong sex bias in how parents and teachers rate children and in how adults rate themselves.

These results provide important information about the participation of children in physical activity at home and in the community. These patterns of participation need closer examination to ensure that options for physical activity are equally available to both boys and girls throughout the life cycle.

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Factors Associated with Health-Related Fitness

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Children who perform well on the mile walk/run test tend to participate in more community-based physical activity, to watch less television, and to be rated by their parents and teachers as more physically active.

Physical educators have long seen promotion of physical fitness in children as a primary goal of their profession. In recent years, public health officials have also begun to recognize the importance of physical activity and fitness during childhood. This recognition is exemplified by the 1980 U.S. government report, *Promoting Health/Preventing Disease: Objectives for the Nation* (U.S. Department of Health and Human Services, 1980). This report identified several objectives pertinent to physical fitness in children. Included were calls for improved monitoring of physical activity and fitness in American children and greater participation by children in cardiorespiratory fitness programs.

For the percentage of children who manifest appropriate physical fitness levels to increase, it seems self-evident that we must understand the factors determining physical fitness in youngsters. While it is well-documented that genetic endowment is one determining factor of physical fitness (Klissouras & Weber, 1973), it is also well-established that exercise habits can profoundly affect physical fitness levels (Haskell, Montoye & Orenstein, 1985). However, most of our knowledge of the effects of physical activity on physical fitness comes from studies of adults or from small-group, controlled exercise training studies in children (Bar-Or, 1983). Little is known about the relationships between many common physical activity behaviors and physical fitness in typical young children.

A major purpose of NCYFS II was to assess the physical activity patterns of six- to nine-year old children and to examine the relationship between these patterns and health related physical fitness. In this article, the associations between selected physical activity factors and two key components of health related fitness—cardiorespiratory endurance and body composition—are reported.

Methods

The physical activity patterns of the children who participated in NCYFS II were assessed by surveys completed by their parents and teachers. A total of 30 individual physical activity factors were examined. These items were designed to assess physical education and other school factors; participation in community-based physical activities; overall physical activity level; television watching time; and parental physical activity. The individual factors, organized into major categories, are listed in Table 1.

Multiple regression analyses were employed to examine the relationships between each of the 30 physical activity factors and two fitness variables, mile walk/run time and sum of skinfold thicknesses (triceps, subscapular, medial calf). Data were analyzed for third and fourth graders (N = 2,372). All regression analyses were conducted by controlling for the effects of variability in age and sex. A relationship was considered significant only if the age/sex-controlled correlation attained the 98 percent probability level ($p < .02$). This relatively stringent standard was adopted because a large number of individual regression analyses were conducted.

Results

The results of the statistical analyses are summarized in Table 1. This table denotes the physical activity factors that were found to be significantly related to mile walk/run performance and skinfold thickness. Also indicated is the "direction" of the significant corre-

lations.

As shown in Table 1, 17 of the physical activity factors were found to be significantly associated with mile walk/run performance. Fourteen factors were significantly associated with sum of skinfold thicknesses. Ten of the factors were significantly associated with both fitness variables. In general, these correlations were relatively low in absolute magnitude with significant multiple correlation coefficients ranging from 0.03 to 0.33. However, it should be noted that, because of the large number of subjects many of these relationships were highly significant ($p < .001$).

Physical education and other school factors. Several factors associated with physical education programming and the school environment were significantly related to distance run performance. Youngsters who performed better on the mile walk/run test tended to receive more of their physical education instruction from a specialist, were more likely to attend schools that conduct physical fitness tests, but were less likely to take physical education outdoors. They also spent less time per day in recess and were less likely to live in a warm climate. These findings suggest that the school's investment of resources in physical education (e.g., physical education specialists, gymnasium) and the curricular emphasis on physical fitness have an impact on the student's cardiorespiratory endurance.

In contrast, school/physical education factors tended not to be significantly related to the children's body composition. Sum of skinfold thickness was significantly associated only with fitness test administration. Leaner youngsters tended to be in programs that administered physical fitness tests.

Participation in community-based physical activities. Factors pertinent to the child's involvement in community-based physical activities tended to be significantly related to cardiorespiratory endurance and several of these were also related to body composition. Youngsters who performed better in the mile walk/run were more likely to participate in activities through Y's, health clubs or spas, sport teams/leagues and scouts. Among the better performers, community activities were more likely to be organized and vigorous. The total number of community sites/organizations through which a child received activity was highly correlated with mile run performance.

Overall, participation in community-based physical activities was also significantly associated with skinfold thicknesses. Leaner youngsters tended to participate in activity through more community sites and were more likely to take activity at Y's and health clubs or spas.

Global ratings of child's activity level. Parent and teacher rating of the child's activity level relative to that of his/her peer group were found to be strongly associated with both fitness variables. Children who were rated by their parents as more physically active tended to be leaner and to perform better in the mile walk/run. The same tendencies were observed when the rating was made by the child's teacher.

Television watching. Time spent by the child watching television (hours per day as estimated by the parent) was significantly associated with both mile walk/run performance and skinfold thickness. Those youngsters who watched more television tended to be fatter and to perform poorer on distance run test.

Parental activity habits. Factors that assessed parental physical activity tended to be significantly related to the child's body composition but not cardiorespiratory endurance. The parents of leaner children tended to have higher activity levels, to exercise more frequently and to exercise with the child more frequently. Only the mother's activity level and the frequency of the mother's exercise were found to correlate significantly with the child's mile walk/run performance.

Summary and conclusions

The results of the analysis presented in this article indicate that the physical activity patterns of children, as reported by their parents and teachers, are significantly related to their physical fitness. Children who perform well on the mile walk/run test tend to participate in more community-based physical activity, to watch less television, and to be rated by their parents and teachers as more physically active. In school, these better performers on the distance walk/run tend to receive more of their physical education instruction from a specialist and to take a physical fitness test.

School factors tended not to be significantly related to the body composition of children. However, leaner youngsters tended to participate in more community-based physical activities and watched less television. These leaner children were rated as more physically active by both their parents and teacher. It may be particularly important to note that parental physical activity was associated with body composition of the children. The parents of leaner youngsters were more active and exercised more frequently with their children.

The results of this study are important because they provide much needed, new information about health-related physical fitness in young children. The data presented here suggest strongly that physical education programs, out-of-school activity habits, and parental activity habits have a significant impact on cardiorespiratory endurance and body composition. Because the participants in this study were drawn as a random sample, the findings can be extrapolated to the population of American third and fourth graders.

In interpreting these findings, this study's limitations should be noted. The design of the study was cross-sectional and, consequently, cause-and-effect relationships should not be inferred from signif-

icant correlations. While the consistent trend was for higher activity levels to be associated with higher fitness, it is not certain that higher activity *caused* higher fitness. Longitudinal studies will be needed to establish a causal relationship. It should also be noted that the correlational analyses presented here were controlled only for variations in age and sex. It is likely that some of the physical activity factors are significantly intercorrelated. More sophisticated analyses will be needed to determine the independent relation of each factor to the fitness variables. Nevertheless, within the limitations cited, the health-related physical fitness of young children is significantly associated with certain physical activity behaviors of the children themselves and their parents.

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EXHIBIT 1. Physical Activity Factors and their Relationships to the Mile Walk/Run and Skinfold Thicknesses

Factor	Significant Relationship With Mile Walk/Run	Significant Relationship With Sum Of Skinfolds
Physical Education and other School Factors		
Percentage of classes taught by P.E. specialist	YES (+)	NO
Minutes in physical education per week	NO	NO
Minutes in recess per day	YES (−)	NO
Percentage of P.E. class time spent in vigorous activity	NO	NO
Minutes of P.E. class time spent in administrative matters	NO	NO
Minutes of activity in average P.E. class	NO	NO
Usually take physical education on school grounds (yes, no)	YES (−)	NO
Warm climate (yes, no)	YES (−)	NO
Fitness tests administered (yes, no)	YES (+)	YES (+)
Percentage of students typically recognized for test participation	NO	NO
Child's Participation in Community-Based Physical Activities		
Public park or recreation department (yes, no)	NO	NO
Church (yes, no)	NO	NO
Sports team or league (yes, no)	YES (+)	NO
YMCA, YWCA, or similar organization (yes, no)	YES (+)	YES (+)
Health club, spa, or private lesson (yes, no)	YES (+)	YES (+)
Brownies, Cub Scouts, or other scouting group (yes, no)	YES (+)	NO
4-H or other farm club (yes, no)	NO	NO
Sum of community activities (seven items above)	YES (+)	YES (+)
Number of community-based activities that were organized	YES (+)	YES (+)
Number of community-based activities that were vigorous	YES (+)	NO
Global Ratings of Child's Activity Level		
Parent's rating	YES (+)	YES (+)
Teacher's rating	YES (+)	YES (+)
Television Watching		
Hours per day child watches TV (parent's estimate)	YES (−)	YES (−)
Parental Activity Habits		
Mother's exercise (days in typical week)	YES (+)	YES (+)
Father's exercise (days in typical week)	NO	YES (+)
Mother exercises with child (days in typical week)	NO	YES (+)
Father exercises with child (days in typical week)	NO	NO
One or both parents exercise with child (days in typical week)	NO	YES (+)
Mother's physical activity level	YES (+)	YES (+)
Father's physical activity level	NO	YES (+)

+ = children scoring higher or answering "yes" scored better on test
− = children scoring lower or answering "no" scored better on test

Photograph by Greg Merker

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The data tapes for the National Children and Youth Fitness Studies I and II may be obtained for a nominal fee from James G. Ross, Macro Systems, Inc., 8630 Fenton St., Suite 300, Silver Spring, MD 20910.